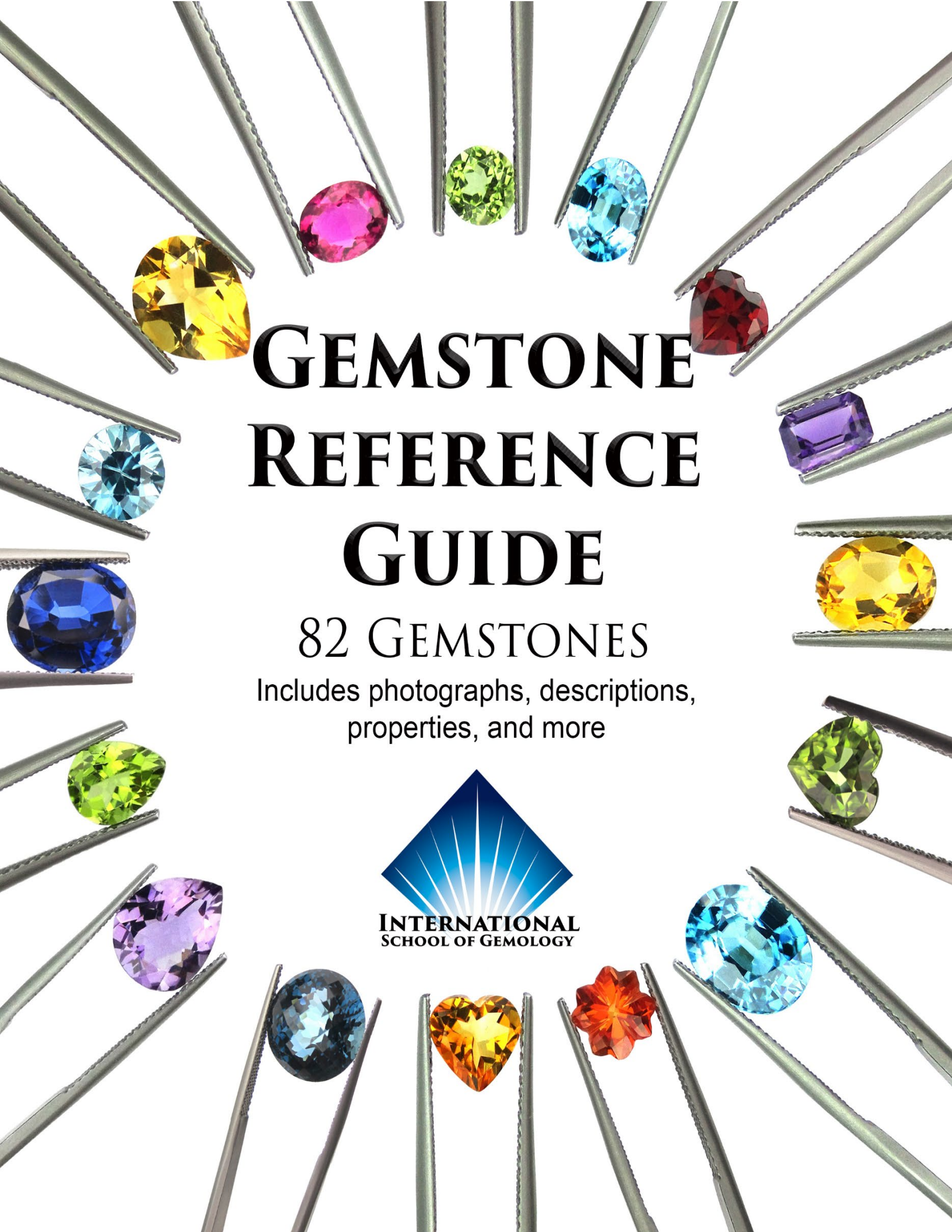

Gemstone Reference Guide

82 Gemstones

Includes photographs, descriptions, properties, and more

International School of Gemology

GEMSTONE REFERENCE GUIDE

82 GEMSTONES INCLUDING PHOTOGRAPHS, IDENTIFICATIONS, DESCRIPTIONS, PROPERTIES AND MORE!

ROBERT JAMES FGA, GG

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1

INTRODUCTION TO GEM IDENTIFICATION

Welcome to the Gemstone Reference Guide, an information resource for 82 of the most often seen gemstones and gem materials. These pages will provide you with a general understanding of the properties of each gemstone, as well as important information regarding specific testing and evaluation methods that should be applied. You must remember, however, that gemstone identification is not a clear-cut science. There are no “textbook” results that you can expect to find with gem identification,except in very rare cases. Because we are dealing with gemstones that form in many places and under varied conditions, even gemstones of the same species will often have variable properties based on differences in elementalor structural formation. For that reason, it is imperative that you remember

that gemstone properties of gemstones can vary. Part of the study of gemology is the study of variables and understanding how and where those variable properties may exist. Once you grasp the concept of variable properties you will have made a major step forward in the ability to perform accurate gem identification.

With that in mind, let us spend time studying the individual gemstones to learn about their formation, properties and how each can be best identified.

2

ABALONE SHELL

Source: Mainly New Zealand, Australia, Japan, and United States. Shells from small sea creatures of the abalone family. Most popular is “rainbow abalone” as seen above.

Chemical: Calcium Carbonate

Formation: Shells of the abalone

Crystal System: None. Organic

Unusual Properties: Can produce abalone pearls but these are rare.

Wearability: Excellent for jewelry items.

RI: None

Birefringence: None
Optic Character: None
Absorption Spectra: None
Specific Gravity: Varies
Hardness: Varies
Transparency: Opaque to translucent

One side of a natural abalone shell.

Special Identifying Properties and Tests: Abalone shell jewelry is rather unique for the intensity of colors that offers more variety of colors that ordinary mother-of-pearl.

Imitations: None known.

3

AGATE

Agate from Agate Creek, Australia

Source: World Wide

Chemical: SiO2. It is a formation of quartz.

Formation: Agates generally form in igneous rocks due to flows of mineral rich water running through fissures in the volcanic rocks. As it flows and cools, if forms layers of silicon oxide (quartz) colored by avariety of trace elements that the hot water solution also contained. It is this layering that creates the famous agate appearance for which this huge family of gemstones is famous. A view of rough “crazy lace” agate is seen below.

Crazy Lace Agate

Crystal System: None. Agates are cryptocrystalline forms of quartz, meaning they are composed of masses of tiny, microscopic crystals rather than being a single crystal formation.

Unusual Properties: Agates contain an endless list of possible properties from fire agate to dendritic moss agate and more.

Wearability: Excellent for jewelry items.

RI: Averages 1.54 - 1.55 just like other quartz, but the refractive index can vary greatly with the type of agate due to impurities that cause the color.

Birefringence: .005 +/-

Optic Character: Uniaxial Positive

Absorption Spectra: Varies

Specific Gravity: Varies

Hardness: Average 8 but can vary greatly.

Transparency: Opaque to translucent

Special Identifying Properties and Tests: Agate will generally be layered while the other famous gem material, jasper, will be a compression of many materials. Agates will usually be in layers of widely variable sizes, shapes, and colors.

Imitations: Many possible and many found on the market. Be careful of plastic imitations which are plentiful throughout the gemstone markets.

4

AMAZONITE

A rare amazonite crystal from Colorado, USA.

Source: India, Brazil, United States, and others. Although named for theAmazon River, it is not found in that location.

Chemical: KAlSi3O8 Amazonite is a member of the feldspar group of minerals. It is a microcline feldspar.

Unusual Properties: The color of amazonite is quite unusual.

Colors: Green to bluish green with many variations possible as seen below with this darker green tumbled amazonite.

Wearability: Excellent.
Transparency: Opaque to translucent

A large rough ammonite specimen.

Special Identifying Properties and Tests: Crystals of amazonite as seen previously are rare. Amazonite usually forms in a massive rock as seen

above, and rarely as crystals. The intense blue green color is normally a strong indicator of amazonite with some white mottling possible.

5

AMBER

Source: Baltic Sea Region and the Dominican Republic, although other sources are reported. Specifically, Romania, the Unites States, Sicily, Myanmar, and Mexico.

Chemical: Mainly a fossilized resin of the ancient pine tree called Pinus Succinifera. Chemical is basically C10H18O.

Formation: Sedimentary deposits of ancient trees up to 50 millionyears in age or greater. Amber is the fossilized resin of tress and is often found to contain small plants and insects from the periods of Jurassic to Cretaceous. Amber should not be confused with copal resin which hasessentially the same source but is nowhere near as old as amber and is therefore not as hardened or long wearing.

Crystal System: None. Organic

Unusual Properties: Amber with identifiable insects and plants is quite rare and valuable. However, care should be taken when buying expensive amber pieces with insects or plants inside. There are numerous reports of amber being heated and softened, and these items being pushed inside an amber piece by the bad guys.

Colors: Light yellow, green, dark reddish orange, and many variations of these as well.

Wearability: Will be damaged by jeweler's torch. Will burn/melt if subjected to heat. Amber has been into many different types of jewelry items for centuries.

Gemological Information: You should be aware that there are treatments being done to amber that significantly impact the colors. Both green and red amber have been found on the market due to HPHT or high pressure and high heat treatment. Some are irradiated. Most of these can be identified using a spectrometer, based on the research by the ISG working in conjunction to the treated amber producers. Below are graphs of the spectroscope reactions to the treated red and green amber. Green treated amber results as below, red treated amber results follows.

Crystal System: None. Amorphous

RI: 1.54

Birefringence: None

Optic Character: None

Absorption Spectra: None

Specific Gravity: 1.03 – 1.10

Hardness: 2 – 2.5

Transparency: Opaque to translucent

Special Identifying Properties and Tests: Several. A hot point will not react quickly with true amber, where it will react very quickly with plastic or copal resin. Amber will also develop static electricity when

rubbed with a cloth and pick up small particles of dust. An additional test to separate from plastic imitations is to weigh it in water and add salt to the mix. As the mixture becomes saturated with salt, the SG of the water will increase past the SG of amber and the amber will float. The only plastic thatis close is Polystyrene but this is used for a pearl imitation and not amber. So, this test should be diagnostic to separate amber from plastic imitations.

Synthetics: No true amber can be synthesized for the obvious reason that amber, by definition, is very old tree sap. However, it should be carefully noted that there are many imitations on the market that are sold as natural.

Imitations: Most often imitated by copal resin and plastic.

6

AMETHYST

Honduran amethyst rough crystal.

Source: By far the greatest source is Brazil. Also found in many other parts of the world including Africa. One of the most famous mines in current production is in Honduras.

Chemical: SiO2. A silicon oxide gemstone.

Formation: Forms in pegmatite dikes as hydrothermal crystals in geode formation. Can occur as very large crystals.

Unusual Properties: Quartz has the unusual property of piezo-electricity, which means it generates electrical frequency when pressure or electrical current is applied to it. As a result, it is used in quartz watches and other frequency control devises. Gem quality amethyst is not used in this manner but this property should be remembered for future purposes.

Colors: Violet to purple. The finest quality will show a red flash effect when rotated under an incandescent light source.

Wearability: Very good. But extreme heat should be avoided as the color can bleach out if heat in excess of 800 degrees F (470C) is applied.

Crystal System: US – Hexagonal…….**World** – Trigonal

RI: 1.544 – 1.553

Birefringence: .009

Optic Character: Uniaxial Positive U +

Absorption Spectra: None that will help.

Specific Gravity: 2.63 – 2.66 average

Hardness: 7

Transparency: Transparent

Special Identifying Properties and Tests: Very difficult to separate from the synthetic amethyst. The use of Brazil law twinning was used for a time but has been found to be questionable as a diagnostic test. The Brazil Law twinning involves the fact that most natural amethyst crystals are twinned. Therefore, under crossed polarizing filters in an immersion cell, this twinning can be seen and the specimen identified as natural. This test has been found to be unreliable, however, as this twinning has been foundin some lab created amethyst Short of some expensive equipment there is not much the ordinary gemologist can do regarding the separate of synthetic amethyst and natural without send the stone to a major gemological laboratory.

Synthetics: Yes. Very prevalent on the market.

Imitations: Many including purple scapolite.

7

AMETRINE

Source: In the current market, Bolivia is producing the world's finestnatural ametrine. You should be very cautious as there is a huge amount of hydrothermally created ametrine on the market sold as natural, and the identification and separation of natural to created is very difficult.

Chemical: SiO2. A silicon oxide gemstone, of the quartz family.

Formation: Forms in pegmatite dikes as hydrothermal crystals in geode formation. Can occur as very large crystals.

Unusual Properties: Ametrine is a rare occurrence of quartz formation where amethyst and citrine are produced within the same crystal. This is due to a change in the chemical composition of the hydrothermal (mineral-rich

hot water) growing environment that causes the colors in amethyst and citrine. Natural ametrine is rare in the finest quality.

Colors: Violet/purple and yellow/orange.

Wearability: Very good. But extreme heat should be avoided as the color can bleach out if heat in excess of 800 degrees F (470C) is applied.

Crystal System: US – Hexagonal…….**World** – Trigonal

RI: 1.544 – 1.553

Birefringence: .009

Optic Character: Uniaxial Positive U +

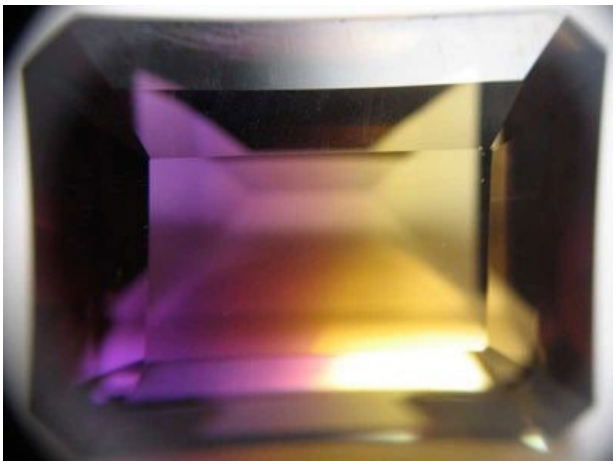
Absorption Spectra: None that will help.

Specific Gravity: 2.63 – 2.66 average

Hardness: 7

Transparency: Transparent

Special Identifying Properties and Tests: Very difficult to separate from the synthetic ametrine. The use of Brazil law twinning was used for a time but has been found to be questionable as a diagnostic test. The Brazil Law twinning involves the fact that most natural amethyst crystals are twinned. Therefore, under crossed polarizing filters in an immersion cell, this twinning can be seen and the specimen identified as natural. This test has been found to be unreliable, however, as this twinning has been foundin some lab created amethyst Short of some expensive equipment there is not much the ordinary gemologist can do regarding the separate of synthetic amethyst and natural without send the stone to a major gemological laboratory.



Lab created, hydrothermal ametrine

Synthetics: Yes. Very prevalent on the market. As seen above, the ability to create very authentic looking ametrine in a lab was perfected decades ago. Always stay with a dealer who can verify the source and authenticity of any ametrine you purchase. If you sell a created ametrine as natural, you are liable for the misrepresentation even if your dealer did not inform you of this. Depending on your dealer to properly disclose information will not protect you if you are the final seller of the material.

Imitations: Many including glass imitations.

8

AMMOLITE

Ammolite

Source: St. Mary's River region of Southern Alberta, Canada is the main source for this gem material.

Chemical: CaCO…calcium carbonate as aragonite.

Formation: Ammonites were hard shelled squid-like marine animals that existed from the Paleozoic to the end of the Cretaceous era when they suddenly became extinct. They were abundant in all of the oceans. The ammolite shell is a calcium carbonate just like other sea shells.

Approximately 65 million years ago the ammonites all died out in a mass extinction that occurred on earth at that time. The ammonite that fell to the sea bottom in the Canadian region were quickly covered up and subjected to millions of years of intense heat and pressure. This caused the calcium carbonate in the shell to transform into aragonite, which is the same material that constitutes pearls. This region of Alberta, Canada is the only region that produces enough of the gem quality ammolite to be financially viable.

Unusual Properties: Ammolite has the unique property of… uniqueness! Because of the orient effect of the aragonite, every ammolite will be different, with a wide variety of colors and combination of colors.

Colors: Almost anything is possible due to the diffraction effect of the aragonite surface.

Wearability: Good. If it has been set properly. The ammolite itself is very fragile. But it is usually set on a base of black onyx and a top of synthetic spinel to give it strength and hardness. Properly set there is no danger in wearing them every day.

RI: Generally, not obtainable as specimens set in doublet or triplet type settings.

Birefringence: None

Optic Character: None

Crystal System: None

Specific Gravity: Not available

Hardness: Extremely soft in natural state

Transparency: Opaque

Special Identifying Properties and Tests: So how, you may be asking, do we identify this gem material? For the experienced gemologist who has had a chance to work with ammolite there is nothing that will come close to it after a simple visual inspection. Expect the onyx/spinel doublet/triplet

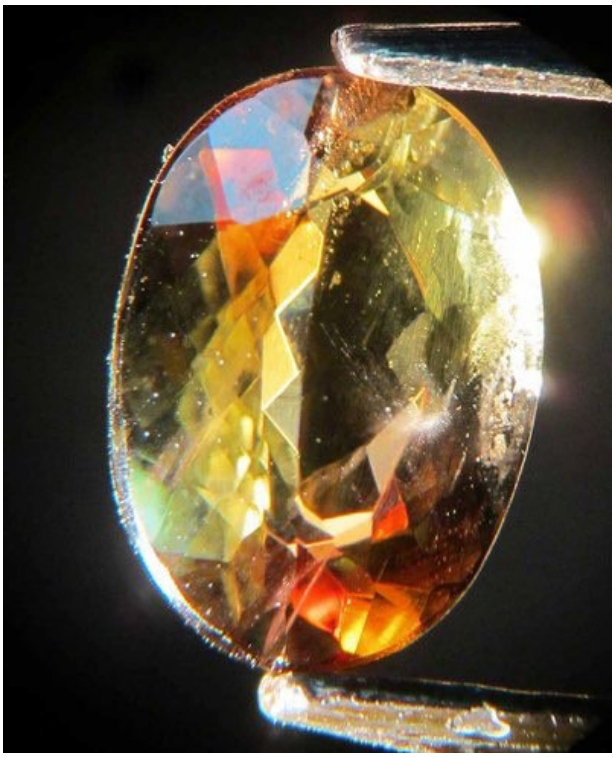
setting as this material is extremely frail without extra protection. But the color and texture of the surface is unmistakable to the trained eye.

Synthetics: None.

Imitations: With difficulty as totally emulating ammonite is very difficult and fakes are easy to spot for the experienced gem dealer or gemologist.

9

ANDALUSITE



Source: Many locations. Named for Andalusia, Spain from where it was first known. It is also found in Brazil, Sri Lanka, Russia, United States, Canada, and Africa. A recent report of a major location in Africa wasbrought to my office by the mine owner. In the coming

year or two you will see a significant influx of this material on the market as these larger size stones work their way through the market supply chain.

Chemical: Al2Si05…Aluminum silicate

Formation: Found mostly in gem gravels and secondary deposits of clay/gravel. Is rarely found as crystals but more often as water worn pebbles and broken pieces.

Unusual Properties: Andalusite offers one of the most pronounced examples of a trichroic gemstone you will find. The colors are so far apart on the spectrum that your eyes can discern all three colors without the useof any gemological instruments. And with the instruments, such as the dichroscope, the distinctness of the colors becomes even more pronounced. Only tanzanite will come close to this property.

Colors: Combination of brown, green, and yellowish to white.

Wearability: Good. With a hardness of 7.5, andalusite makes some nice jewelry items because it wears well in spite of large sizes not being on the market yet.

RI: 1.633 – 1.648 possible ranges

Birefringence: .007

Optic Character: Biaxial Negative B-

Crystal System: Orthorhombic

Specific Gravity: 3.12 – 3.20 range

Hardness: 7.5

Transparency: Transparent

Spectrum: Faint band in the 450-500 range is possible. The spectrum will vary based on the location from which the stone is found. Lines are faint but visible. However, the dichroscope should preclude any need for the spectroscope.

Special Identifying Properties and Tests: The separation of colors with a dichroscope should be diagnostic for an experienced gemologist. Below is a composite photograph of a single andalusite crystal in a London

dichroscope. The color separation through a dichroscope will be a diagnostic identification for a properly trained gemologist or gemstonedealer.

Single andalusite seen through both sides of a London dichroscope.

Synthetics: None.
Imitations: With difficulty

10

APATITE

Apatite

Source: Numerous places around the world including Sri Lanka, India, Madagascar, United States and Mexico

Chemical: Ca5(F,Cl,OH)(PO4)3…a calcium phosphate that you will not need to remember.

Yellow apatite crystal.

Formation: Prismatic crystals as seen above. Can be yellow or neon blue in natural formation.

Unusual Properties: None to speak of, other than a very nice neon color when cut properly.

Colors: Mainly will occur in neon yellow and neon blue/green. The yellow apatite is sometimes difficult to find for jewelry, but the blue/green colors are becoming quite popular. Can also occur in pink and violet colors, as well as colorless.

Wearability: Apatite does not wear so well in rings due to its rather soft Mohs Scale listing of 5…which would normally preclude it from being considered a gemstone material. However, when set in earrings and necklaces, it wears well and makes for some very pretty jewelry items at an affordable price level.

Optic Character: Uniaxial Negative U-

Crystal System: Hexagonal

Specific Gravity: 3.15 – 3.22 range

Hardness: 5

Transparency: Transparent to translucent in cat's eye

Spectrum: One of the best absorption spectra for spectroscope practice. Apatite has a strong absorption band in the 570 region as shown. This is actually a grouping of absorption lines divided by very small spaces, but

appears to be an absorption region when viewed with a hand-held spectroscope.

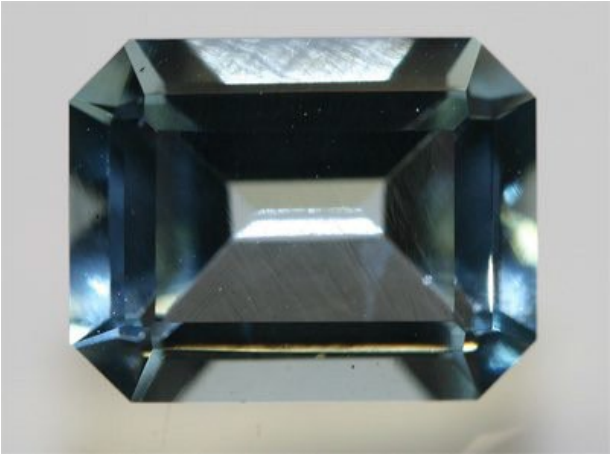
Special Identifying Properties and Tests: The absorption spectrum is diagnostic, as no other gemstone is going to give you this exact reaction to the spectroscope.

Treatments: On a major television shopping channel, a red apatite was recently introduced into the market as coming from a single mine source. This proved to be a false claim as the red apatite color was produced by irradiation and not natural. Great care should be taken when considering new gemstone reports on the market that have not been properly tested and verified.

Imitations: None known.

11

AQUAMARINE



Aquamarine

Source: Numerous places around the world including Brazil, Nigeria,and United States.

Chemical: Be3Al2(SiO3)6

Formation: Prismatic crystals

Unusual Properties: None.

Colors: Finest untreated color is a greenish blue. Heated the stone will turn pure blue. Light blue is often seen as inexpensive variety of aquamarine on many world markets. Darker blue and natural greenish blue have become rather rare and are expensive.

Wearability: Very good.

Refractive Index: 1.577 – 1.583 and can vary based on iron content.

Birefringence: .005 – .008

Optic Character: U-

Crystal System: Hexagonal

Specific Gravity: 2.67 – 2.75 range

Hardness: 7.5 – 8.0

Transparency: Transparent to translucent.

Spectrum: Weak bands in the 456nm, 427nm and 537nm possible.

Special Identifying Properties and Tests: Anything with the above colors in the beryl family will be aquamarine.

Imitations and Created: Many possible. Often confused with bluetopaz. Very fine quality hydrothermal aquamarines are on the market. Hydrothermal aquamarine is an easy identification with magnification for a trained gemologist.

12

AXINITE

What color is it?: Primarily reddish brown as shown above. But it can also occur in yellow, blue, violet, and grey among other colors.

What is the story behind this gemstone?: A rare and unusual gemstone more for collectors than consumers. These stones will be small and expensive. It is named for the axe shape of the original crystal formations.

Can I wear it every day?: You can but probably will not want to.

Is it expensive?: It can be in large sizes.

Is it a birthstone?: No

What do I need to know before going shopping? Plan on adding to your gem and mineral collection more than your jewelry ensemble. This

will be a difficult stone to find. Although no collection will be really complete without one.

Source: Mexico, France, and US

Chemical: Ca2(Fe+2,Mn+2)Al2BSi4O15(OH) a long complicated chemical equation for such a small stone

Formation: Forms in metaphoric rocks whose origins are calcium rich sedimentary rocks such as limestone

Crystal System: Triclinic

Unusual Properties: None

RI: 1.675 - 1.685

Birefringence: .010

Optic Character: B -

Specific Gravity: 3.27 + -

Hardness: 7

Transparency: TP - TL

Special Identifying Properties and Tests: None

Synthetics: None

Imitations: Many possible but not likely. Confused with smoky quartz.

13

AZURITE

Azurite

Source: Mainly as part of copper deposits in Chile, Russia, United States, France, and Australia

Chemical: CuCO3Cu(OH)2 a copper carbonate

Formation: Forms in small crystals occasionally, but mainly as an aggregate with malachite in copper deposits as seen above.

Unusual Properties: None really, just a nice “earthy” look to it when cut as beads and cabochon gemstones.

Colors: Blue.

Wearability: Only as beads and cabochons of various shapes. Azurite is fairly soft so it does not do well for rough wear.

Azurite bead bracelet with 14 kt gold accents.

RI: 1.730 – 1.838

Birefringence: .108

Optic Character: Biaxial Positive B+

Crystal System: Monoclinic

Specific Gravity: 3.77 – 3.89 range

Hardness: 3.5 to 4

Transparency: Transparent (rare) to opaque

Spectrum: None of any importance.

Special Identifying Properties and Tests: The combination of blue azurite and green malachite is pretty much a throw down for identification. There is not much else out there that will give you this combination of colors.

Synthetics: None.

Imitations: None known. Azurite alone can be confused with lapis lazuli and a few others but will rarely be found in pure blue color.

14

BENITOITE

Photo courtesy of Capistrano Mining Company

Source: San Benito County, California, USA is the only place this gemstone is found.

Chemical: $BaTiSi_3O_9$

Formation: Very small prismatic crystals

Unusual Properties: None to speak of, other than the rarity factor and the fluorescence that this gemstone offers. Quite dramatic as we will see shortly.

Colors: Light blue to dark blue as seen above. Some reports of a pink variety as being possible.

Wearability: Benitoite will wear fairly well with a hardness in the 6.5 range. Due to the per carat cost of the stone, and the rarity, it is difficult to find on the open market.

RI: 1.757 – 1.804

Birefringence: .047 average

Optic Character: Uniaxial Positive U+

Crystal System: Trigonal

Specific Gravity: 3.64 – 3.68 range

Hardness: 6 – 6.5

Transparency: Transparent

Spectrum: None of any use to the identification

Special Identifying Properties and Tests: Very specific reaction to short wave fluorescence makes testing benitoite easy once you have seen it. This is another reason why gemologists need to learn the individual characteristics of gemstones and not just the properties. Once you know what to look for with benitoite, you can separate it from a blue sapphire very, very easily….in spite of benitoite having RI, SG, and optic character very, very close to a blue sapphire. Close enough, in fact, that it can be mistaken for a sapphire. A very costly mistake since benitoite is much moreexpensive on a per carat basis than most sapphires.

Synthetics: None.

Imitations: None known that will give you the above reaction.

15

BOULDER OPAL

Koroit Opal from Australia.

Source: Most important deposits in Australia, Brazil, and US (Nevada).

Chemical: SiO2 with H2O

Formation: Boulder opal is unique in that it forms from silicon rich water seeping into crevices and openings in existing host rock. As the water evaporates and the silicon forms the diffraction grating formation of silicon nodules, the result is opalized seams in the original host rock. The most famous is the Koroit Opal of Australia as seen above.

Unusual Properties: Endless. Every opal is unique. And the color and pattern possibilities are endless. Opal do occur showing asterism and chatoyancy.

Colors: Endless.

Wearability: Fair. Opals have a hardness that averages 6 on the Mohs Hardness Scale. It makes better necklaces and earrings than rings as far as long-term wear is concerned.

RI: 1.44 – 1.46

Birefringence: None

Optic Character: None

Specific Gravity: 2.10 average but can vary widely based on the amount of water contained in the stone.

Crystal System: Amorphous: no crystal structure

Hardness: 6 average

Transparency: Translucent to Opaque

16

BUMBLEBEE

A slice of bumblebee from the inside of a volcano.

Source: World Wide possible, anywhere volcanic activity is present.

Chemical: A combination of minerals possible including hematite, arsenic gypsum, and the most important element: sulfur. The yellow color is due to sulfur with the others making up the balance of this gem material.

Formation: There is a debate on whether bumble should be called ajasper or agate. Based on it being a conglomerate of several minerals, itshould be correctly referred to as a jasper. The bumblebee material formsfrom residual mineral deposits on the inside of the cone of active volcanoes.**Unusual Properties**: None to speak of, other than the color which is very unique. As seen in the image above, bumblebee can offer a beautiful

yellow layering with purple matrix colors due to the presence of gypsum.

Colors: Many shades of yellow and purple, with other combinations possible. All should have a significant amount of the yellow colors to be the finest quality of bumblebee.

Wearability: Excellent

RI: None

Birefringence: None

Optic Character: None

Crystal System: None

Specific Gravity: Varies greatly with mineral combinations.

Hardness: Varies greatly with mineral combinations.

Transparency: Opaque

Spectrum: None of any use to the identification

Special Identifying Properties and Tests: Visual observation will be diagnostic for bumblebee. Nothing else on the market is like it.

Synthetics: None.

Imitations: None known that will give you the above reaction.

17

CAYMANITE

Consumer Information

What color is it?: As you can see here, **caymanite** can occur in a variety of what is called **earth colors**. That being various colors of brown, yellow, to white colors.

What is the story behind this gemstone?: Caymanite was formed millions of years ago when the volcano that formed the Cayman Islands rained ash down on the rocks below. The ash formed sediments that eventually hardened into a sedimentary rock with the colored layers forming, based on the mineral content of the various layers of ash.

Can I wear it every day?: Yes, caymanite wears very well.

Is it expensive?: It can be. The darker colors which are shown above can be rather expensive in jewelry items. But the lighter colors shown in the earrings above are affordable for any budget.

Is it a birthstone?: No...but you will never convince the Cayman Islanders of that.

What do I need to know before going shopping?: It will be hard to find outside the Cayman Islands. One store there, Kirk Jewellers, has an exclusive agreement on a very fine line of jewelry from KABANA that is made with very fine quality caymanite. Other than traveling to the Cayman Islands to shop, however, it will be difficult to locate this gemstones.

Source: The Cayman Islands exclusively

Chemical: Mainly layers of manganese, iron, and other volcanic minerals

Formation: In rock as sediments that harden to form sedimentary rocks

Crystal System: None

Unusual Properties: None other than the very unusual layering of the colors.

RI: Varies with mineral content

Birefringence: None

Optic Character: None

Specific Gravity: Varies with mineral content

Hardness: 5

Transparency: Opaque

Special Identifying Properties and Tests: The colored layering of caymanite it unlike almost anything else on the market.

Synthetics: None known

Imitations: None known.

18

CHAROITE

Charoite

Source: This stone was discovered in 1976 in the USSR close to the Charo River, from which it got its name. Unfortunately, the gemstone has been very popular and at last report the mining of the stone has ceased due to limited sources being available.

Chemical: K(Ca,Na)2 Si4O10(OH,F),H2O which means it will probably not be synthesized soon.

Formation: In massive rock formations, most likely igneous in nature.

Unusual Properties: None to speak of, other than the highly unique coloration pattern that charoite gives. There is nothing else quite like it in the world.

Colors: Mottled purple to slight bluish with white veining.

Wearability: Very good.

RI: 1.55 +/-

Birefringence: None

Optic Character: None. (aggregate)

Crystal System: None (aggregate)

Specific Gravity: 2.68 range

Hardness: 7

Transparency: Opaque

Spectrum: None of any use to the identification

Special Identifying Properties and Tests: Hard to miss charoite due to the unique structure and combination of colors.

Synthetics: None.

Imitations: None that are plausible.

19

CHRYSOBERYL

Source: Most chrysoberyl comes from Brazil. There were mines in Russia for many years but most of these have played out. Minor sources include those in the Far East.

Chemical: BeAlO2. Chrysoberyl is a sister stone to the emerald and other beryls with the difference being that beryls are silicates while chrysoberyl is an oxide.

Formation: In pegmatite dikes.

Unusual Properties: Chatoyancy (cat's eye) and color change are the most prevalent.

Colors: Transparent stones are golden brown as seen above. The honey color of chrysoberyl cat's eye is considered the most valuable color.

Alexandrite will be a reddish color in incandescent light and turn to variable colors of green in fluorescent light.

Wearability: Very good.

RI: 1.746 – 1.755

Birefringence: .008 +/-

Optic Character: Biaxial Positive B+

Crystal System: Orthorhombic

Specific Gravity: 3.73 +/-

Hardness: 8.5

Transparency: Transparent to translucent

Spectrum: Alexandrite will show the distinct railroad tracks of chromium. A textbook image is shown here.

Special Identifying Properties and Tests: Several possible.Alexandrite will show distinct absorption lines for chromium and will give red reaction to the Chelsea filter due to chromium. The chatoyant cat's eye as shown below will have an eye that appears to float in the finer qualities. As you turn the stone the eye will appear to open and close. The sharpness of the eye, distinct opening and closing of the eye, and uniform shape and location of the eye will count a great deal toward the quality and the valueof the cat's eye chrysoberyl.

Synthetics: Alexandrite has been synthesized. The synthetic processes use both flux and pulled processes.

Imitations: Since 1890, a flame fusion synthetic corundum has been on the market that imitates alexandrite. This is a synthetic corundum doped with vanadium to give the color change effect. RI, spectroscope, Chelsea filter, SG will all serve as diagnostic tests to separate synthetic corundum from natural alexandrite.

20

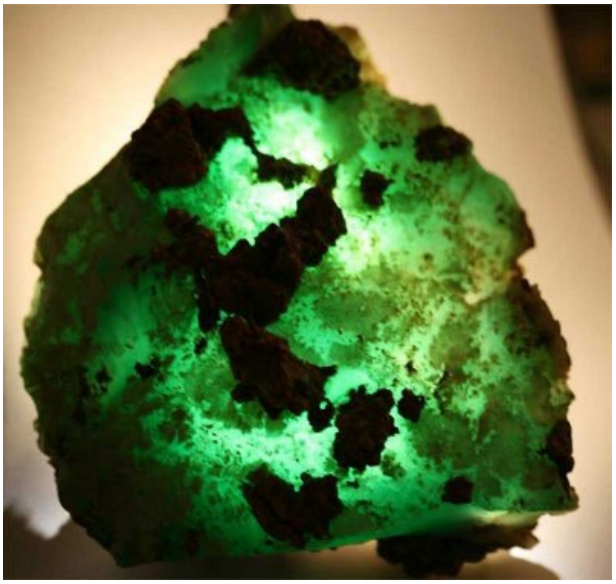
CHRYSOPRASE

Chrysoprase from the Candala Mine in Australia.

Source: There are many sources possible including Brazil, Russia, India, and South Africa. However, the most active production is from Australia, which is the source of the chrysoprase rough you see above. Currently, Australia is the world's largest producer and the finest quality chrysopraseis coming from the Land Down Under.

Chemical: SiO2. Chrysoprase is a form of chalcedony, being a silicon oxide.

Formation: In hydrothermal veins associated with nickel ore deposits. It is the nickel in chrysoprase that gives it the green color.



Chrysoprase viewed with back lighting showing beautiful green translucent structure.

Unusual Properties: None of note other than the beautiful translucent green color that is unlike almost any other gemstone. Chrysoprase will be the most expensive, and most rare, of the chalcedony group of cryptocrystalline quartz gemstones.

Colors: Chrysoprase is a beautiful green color that is translucent, emulating top quality jadeite, in the best qualities.

Wearability: Very good.

RI: 1.530 – 1.539

Birefringence: .006 +/-

Optic Character: Uniaxial Positive U+

Crystal System: Trigonal

Specific Gravity: 2.62 +/-

Hardness: 7

Transparency: Translucent to opaque

Spectrum: None that is diagnostic.

Special Identifying Properties and Tests: Will test in the chalcedony range of quartz. Based on the color, along with RI and SG readings, identification should be no problem for the experienced gemologist. Can be dyed to enhance color but an immersion cell and magnification should be diagnostic as color zones will occur in naturally present fissures in the stone.

Synthetics: None known at this time.

Imitations: Many possible including plastic, glass and perhaps jade. Can be confused with jadeite in finer qualities. However, a cursory RI test can easily separate chrysoprase from jadeite.

21

CITRINE

Brazilian Citrine

Source: The most prevalent is Brazil, although other sources are possible such as United States, Russia, and Spain.

Chemical: SiO2. A member of the quartz family

Formation: In hydrothermal veins and pegmatite dikes.

Unusual Properties: None.

Colors: As shown top left, citrine can occur in light yellow/brown to golden to Madeira colors. The finest will have a reddish tint and be of the Madeira color grade.

Wearability: Very good.

RI: 1.544 – 1.553

Birefringence: .009 +/-

Optic Character: Uniaxial Positive U+

Crystal System: Trigonal

Specific Gravity: 2.62 +/-

Hardness: 7

Transparency: Transparent

Special Identifying Properties and Tests: Bulls eye interference figure through a polariscope is diagnostic for citrine / quartz. Beyond that, none are relevant. Based on the color and other readings, citrine should pose no threat to the experienced gemologist for identification.

Synthetics: Synthetic quartz is very prevalent in the market. At this time, it is quite difficult for the average gemologist to separate the syntheticfrom the natural. However, as much natural citrine is available on themarket, it will not be a usual occurrence to find synthetic citrine.

Imitations: Many possible including plastic and glass.

22

CONCH PEARL

Source: The warm waters of the Caribbean are the only home to the Queen Conch that produces the conch pearl (pro: **conk**)

Chemical: Concretion of conchiolin

Formation: As naturally occurring pearls in the gastropod Strombus Gigas. These are non-nacreous pearls that are extremely rare.

Unusual Properties: Flame structure of conch pearl is its most famous feature and identifying characteristic. Notice the flame structure shown at

left. This is a classic conch pearl appearance and will be the most important factor regarding price…along with the other grading characteristics of blemish, size, and shape.

Colors: Orange to yellow colors are most often found but can range toa wide variety of pinks to white.

Wearability: Good for pendants and earrings when they can be found to match. Not recommended for rings and bracelets as wear and tear on the pearls is non-repairable.

RI: Varies

Birefringence: None

Optic Character: None

Crystal System: None

Specific Gravity: Varies

Hardness: 3 – 4

Transparency: Opaque

Spectrum: None

Flame structure of conch pearl.

Special Identifying Properties and Tests: The flame structure should be diagnostic to an experienced gemologist, or anyone else who has seen conch pearls previously. The flame structure is unique in the world of gemology.

Synthetics: None

Imitations: None known at this time.

23

CORAL

Natural, untreated red color from Italy.

Source: World-wide

Chemical: Calcium carbonate

Unusual Properties: None

Colors: Wide variety of colors available, both natural and treated.

Wearability: Good to moderate. Natural coral is organic and care must be taken when wearing.

RI: 1.4 - 1.6 (varies widely due to organic structure)

Birefringence: None

Optic Character: none

Specific Gravity: 2.65 average

Crystal System: Trigonal (aragonite crystals)

Hardness: 4 average

Transparency: Opaque

Special Identifying Properties and Tests: True coral will have polyps visible, even when dyed. Very susceptible to acids. The harvesting of corals for jewelry has been frowned upon for many years by the environmental community world-wide.

Synthetics and Treatments: Wide variety of created and treated pearls on the market, including all types of color dyes and radiation treatments. The study of pearls must include an in-depth study of treatments.

24

DANBURITE

The only reasons to include this rather obscure gemstone in this reference is (1) it has properties very close to topaz that could cause you problems if you are not aware of it, and (2) it is one of the best stones to practice finding a biaxial optic interference figure. Either of these is enough to include it here. Danburite is not a household name in the gemstone world but has been around for a while and could well find its way to your desk. Named after the place where it was first discovered, Danbury, Connecticut

in the USA, it offers some interesting gemological properties that make it well worth having in your reference library and collection.

Source: USA, Mexico, Myanmar, and other locations.**Chemical**: Ca(B2Si2O8) Calcium boric silicate **Formation:** No information available

Unusual Properties: None

Colors: Colorless, light yellow, light pink.

Wearability: Good **RI:** 1.630 – 1.636

Birefringence: .006

Optic Character: B –

Specific Gravity: 3.00

Crystal System: Orthorhombic

Hardness: 7

25

DIAMOND

Diamonds

Source: Many locations throughout the world. Most notably Botswana, Russia, Australia, South Africa, Canada, and many others.

Chemical: C (carbon)

Formation: Diamonds crystallized as far as 150 kilometers deep in the earth up to 3 billion years ago. The heat and pressure required to force the crystallization of carbon can only be found that deep in the earth. And the diamonds were brought to the surface at a very, very fast rate by kimberlite magma. This kimberlite traveled in excess of 500 km/p/h which was required for the diamonds to stay crystallized and not return to their previous carbon gas state.

Unusual Properties: Perhaps the most known is the hardness of diamond. Listed as a 10 on the Mohs Hardness scale, diamond is actually farther up the scale if the scale were proportional rather than relative. Also of note is diamond's ability to diffract light into its spectral colors. This dispersion is one of the properties that make diamonds valuable.

Colors: Many possible. Most often colorless or with tints of brown to yellow.

Can be found in a rainbow of colors on rare occasions. Treatments can produce additional colors.

Wearability: With a hardness of 10 about the best you can find. However, the hardness of diamond should not be confused with its ability to break fairly easily if hit in the right direction.

General: Care should be taken when observing a diamond to use the proper light source for grading and inspection. As seen above, overhead fluorescent is proper for inspecting diamond surface features. The surface

of this diamond has a cavity due to a pulled-out crystal that was included in the stone. The best viewing of this feature is with overhead light.

RI: 2.41

Birefringence: None

Optic Character: Isotropic

Crystal System: Cubic. Usually as octahedral as shown at top of this page.

Specific Gravity: 3.52

Hardness: 10 on Mohs Scale. If rated proportionately to other gemstones diamond would be 40.

Transparency: Transparent

Spectrum: Varies Special Identifying Properties and Tests: A number of tests can easily separate diamond from its imitations. Such as thedoubling of facets in a synthetic moissanite, or the softer and more round facet junctions of CZ.

Synthetics: Yes. Difficult to identify without some high-tech equipment at this stage. However, this may soon change as technology increases and the cost of the equipment decreases.

Imitations: Many. Particularly cubic zirconia, synthetic moissanite, synthetic rutile, and others.

Treatments: Laser drilling to improve clarity, fracture filling to improve clarity, HPHT treatment for color enhancement.

26

DIOPSIDE

Chrome Diopside

Diopside

Source: Many around the world including India, South Africa, Italy, and Austria.

Chemical: CaMg(Si2O6) Calcium Magnesium Silicate

Formation: Occurs as prismatic crystals.

Unusual Properties: The 4-rayed star of star diopside is unique. **Colors:** Intense green to yellowish green, violet, and black **Wearability:** Very good.

RI: 1.671 – 1.726

Birefringence: .028 +/-

Optic Character: Biaxial Positive B+

Crystal System: Monoclinic

Specific Gravity: 3.30 +/-

Hardness: 6

Transparency: Transparent

Spectrum: Varies

Special Identifying Properties and Tests: Four rayed star and RI are diagnostic for black stones with asterism. Easily identified by spectrum with chromium diopside.

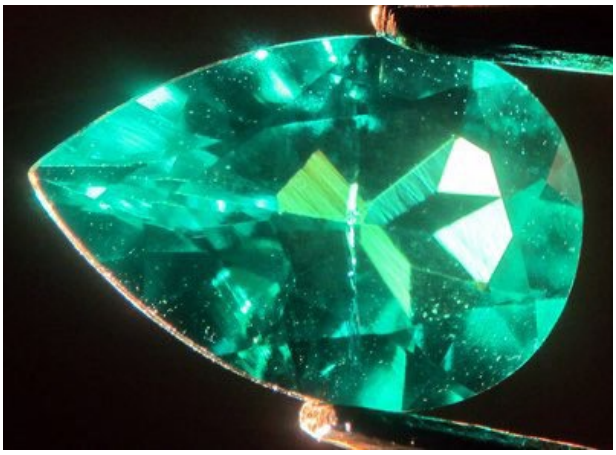
Synthetics: None known.

Imitations: Many possible. Care should be taken not to confuse a 4-rayed black star diopside with a 6-rayed black star sapphire.

Treatments: None known.

27

EMERALD



Source: Many around the world including Colombia, Zambia, Brazil, India, and others

Chemical: BeAlSio2

Formation: Forms in hydrothermal vents.

Unusual Properties: A variety including cat's eye and others.

Colors: Green with various modifying colors possible including blue and yellow.

Wearability: Good. Emerald suffers a bad rap due to the oiling of stones hiding existing heal fractures. Some of these stones are subject to chipping along these fracture lines. However, a fine quality emerald will

have few of these heal fractures and will wear quite well under normal circumstances.

Unusual Properties: The finest emeralds are colored by chromium and will give a red reaction to the Chelsea Filter. In some parts of the world any emerald not colored by chromium, but rather by vanadium, is called a green beryl. One of the most unusual emerald formations is the **trapiche** emerald that shows a wagon-wheel type formation. This is caused by tiny inclusions of colorless beryl or albeit filling in at the crystal junctions to form a radial pattern. This type of emerald the Spanish miners called **trapiche,** which is a Spanish word for a type of gear wheel. These emeralds are reported to be found in both the Muzo and Chivor mines of Colombia,

RI: 1.577 – 1.583

Birefringence: .005 – .009

Optic Character: U-

Crystal System: Hexagonal

Specific Gravity: 2.72

Hardness: 7.5

Transparency: TL – TP

Special Identifying Properties and Tests: Red reaction to Chelsea Filter will confirm chromium content as shown at left. A marquise cut Colombian emerald in regular light and through a Chelsea Filter showing the red reaction due to chromium content. An excellent indicator for Colombian origin since few other world sources produces chromium-based emeralds in commercial quantity.

Chatham Created Emerald using the flux-melt process.

Synthetics: Many including hydrothermal and flux growth synthetics. Identification and separation can be done easily using magnification to inspect diagnostic inclusion, a spectroscope to inspect chromium content, and a Chelsea filter reaction for the very experienced gemologist.

Imitations: Many.

28

ENSTATITE

Source: The main source is India. Additional sources include Sri Lanka and South Africa.

Chemical: Mg(Si2O6) Magnesium Silicate

Formation: Occurs as prismatic crystals.

Unusual Properties: Makes a beautiful cat's eye variety.

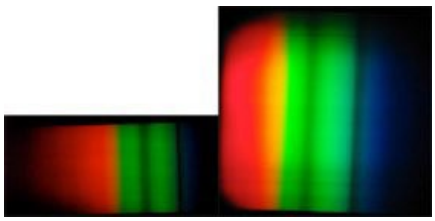
Colors: Normally brown to reddish brown as seen above. Can also occur in a greenish gray color.

Wearability: Good, although this is not a gemstone you will see normally in jewelry stores.

RI: 1.663 – 1.673

Birefringence: .010 +/-

Optic Character: Biaxial Positive B+
Crystal System: Orthorhombic
Specific Gravity: 3.27 +/-
Hardness: 5 1/2
Transparency: Transparent



A composite view of enstatite through a diffraction grating and prism type spectroscope.

SPECTRUM: Has a very nice absorption band in the 5400 range as seen above. This is a great gem specimen to practice your spectroscope skills.

Cat's eye enstatite.

Special Identifying Properties and Tests: Spectrum is diagnostic. Best is viewed using a prism type spectroscope. At left are images taken using both diffraction grating and prism. Note the diagnostic spectrum visible in each, with the prism type being a bit more focused due to the strong absorption line (double line) in the blue/green.

Synthetics: None known.

Imitations: Many possible including smoky quartz.

Treatments: None known.

29

FIRE AGATE

Source: The main source is Mexico and Arizona in the USA.

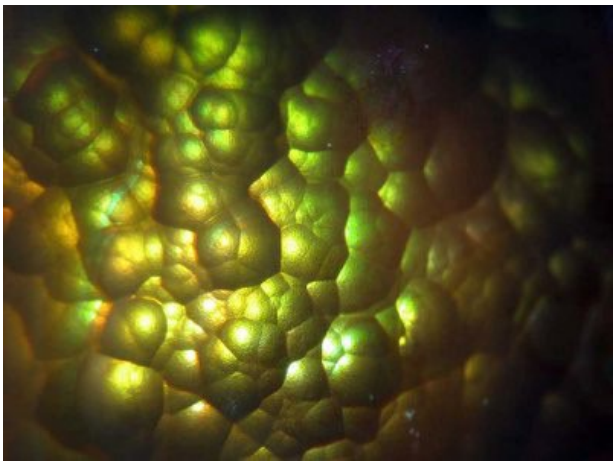
RI: 1.530 – 1.540

Birefringence: .005 +/-

Optic Character: Uniaxial Positive U+

Chemical: SiO2 Silicon Dioxide (quartz)

Formation: Fire Agate is a member of the chalcedony family of cryptocrystalline quartz.



Unusual Properties: Very unique display of what appears to be burning embers as seen above. Most unusual and nothing else offers this type of optical illusion.

Colors: A beautiful array of browns, red and yellows as seen above.

Crystal System: Trigonal

Specific Gravity: 2.62 +/-

Hardness: 7

Transparency: Translucent

Spectrum: None

Special Identifying Properties and Tests: None needed. Nothing else will give you the fire agate effect.

Synthetics: None known.

Imitations: None that are believable.

Treatments: None known.

30

FIRE OPAL

Source: Mexico is the most famous, but sources are located around the world.

Chemical: SiO2

Crystal System: Amorphous

Unusual Properties: Unlike traditional opal, fire opal is generally orange to reddish orange, and translucent to transparent. The term *fire opal* is widely mis-applied to other types of opal under the incorrect assumption that opals of brilliant colors can also be called fire opal. The fact is that fire opal will be the reddish-orange color seen above and will usually be faceted. Care should be taken when cutting as a stabilization period after mining has been widely reported for rough fire opal.

RI: 1.450

Birefringence: None

Optic Character: Single Refractive

Specific Gravity: 2.15

Hardness: 6 average

Transparency: Translucent to Transparent

Special Identifying Properties and Tests: Play of color, low refractive index, SG, magnification should be diagnostic.

31

FLUORITE

Fluorite

Fluorite has taken its place as a significant gemstone due in part to its wonderful array of colors, and the fact that it is very affordable. Although fairly soft with a Mohs Hardness of only 4, it has become very popular for pendants and earring jewelry items. The most prized is the fluorite from the United Kingdom area of Derbyshire known as “Blue John.” This is a historical gemstone source for a very fine quality and quite rare pure blue form of the material.

Source: United Kingdom, Germany, China, and others.

Chemical: CaF2 a calcium fluoride

Formation: Varies

Unusual Properties: Very unusual color banding possible as seen above.

Colors: Wide variety of colors are possible, in a wide variety of combinations.

Wearability: Limited to pendants, necklaces, and earrings usually. Too soft to wear in rings for most designers. Blue John from Derbyshire, United Kingdom is a very famous type of fluorite used for jewelry for manydecades.

RI: 1.434

Birefringence: .00

Optic Character: Isometric (cubic)

Specific Gravity: 3.18 range

Crystal System: Cubic

Hardness: 4 average

Transparency: Transparent to translucent in gem quality.

Special Identifying Properties and Tests: Usually strongly fluorescent. But colors combinations and RI should make identificationeasy.

Synthetics: Can be synthesized but there is little reason based on the abundance of material available.

Imitations: Many possible.

32

GARNET

Rhodolite, pyrope and hessionite garnets.

Garnet

Source: World Wide locations based on the specific group. Based on garnet being an isomorphous replacement series of gemstones, the locations and properties of each group will vary.

Chemical: An isomorphous series replacement group. Chemicals runs from magnesium aluminum silicate to calcium chromium silicates. However, the binding factor that makes garnets a related group is the fact that they are all silicates and share many of the same properties such as crystal system and a close proximity range of refractive index readings.

Formation: In igneous rocks, usually as dodecahedral crystals.

Unusual Properties: Varied. Color change, asterism and chatoyancy are possible.

Colors: Wide array of colors. Mainly running from green to yellow to red to brown.

A rainbow of garnets showing the amazing colors available.

Wearability: Very good. Garnets make excellent jewelry items as they are high a high level of tenacity in their crystal structure.

Important note about garnet properties. Due to garnets being an isomorphous replacement series, the actual readings within any one group can vary, just as the numbers from group to group will vary. This is because a pyrope garnet, for instance, can have variable chemical make-up within the magnesium aluminum silicate formula. In other words, a little more of this, a little less of that….means that the RI of pyrope garnet can vary. So, as you read the RI ranges below it is not because the stones are anisotropic, but because the isotropic RI reading can vary from stone to stone. Please remember this as you test garnets or you will go crazy trying to figure out what is going on with your refractometer.

Refractive Index

Pyrope: 1.73 – 1.76

Almandine: 1.78 – 1.81

Spessartite: 1.79 – 1.81

Grossular: 1.73 – 1.74

Demantoid: 1.88 (rarely varies)

Uvarovite: 1.87 +/-

Birefringence: None

Optic Character: None (isometric)

Crystal System: Cubic or Isometric

Specific Gravity:

Pyrope: 3.70 + / – Almandine: 4.00 + / – Spessartite: 4.15 + / – Grossular: 3.65 + / – Demantoid: 3.82 + / – Uvarovite: 3.77

Hardness: 7 to 7 1/2 on average for all.

Transparency: Translucent to Transparent

Spectrum: Varies widely. The spectrum will vary as the garnet you are testing varies within the group. So, the study of the spectroscope using garnets is a great place to see some "easy to see" and very interesting, absorption bands and lines.

A collection of green grossular garnets.

Special Identifying Properties and Tests: Very little in the 1.73 to over the limit RI range that will be cubic that will not be garnet. The biggest problem with identification of garnets is trying to find out which group a specific stone comes from. However, for general identification in that RI range with single refractive gemstones, there is just not much else out there but garnet.

Synthetics: Yes. YAG or yttrium aluminum garnet has been synthesized to make imitations of many gemstones. No synthetics out there that take the place of a garnet, however.

Imitations: Many possible due to the wide variety of colors of garnet. But the RI and SR nature of garnet makes it pretty easy to identify and separate from the imitations.

Treatments: Color infusion by artificial methods is known to happen but is rarely discussed in the journals.

33

GASPEITE

Source: Almost exclusively from Gaspe, Quebec, Canada….for which it is named.

Chemical: (Ni,Mg,Fe)Co3 A member of the calcite group of minerals

Formation: In volcanic rock formation

Unusual Properties: None

Colors: A very nice earth tone of green to yellowish green.

Wearability: Very good.

RI: 1.61 – 1.83

Birefringence: -.22

Optic Character: Uniaxial Negative U-

Crystal System: Trigonal

Specific Gravity: 3.21

Hardness: 5

Transparency: Opaque

Spectrum: None

Special Identifying Properties and Tests: Very little on the market that will look like Gaspeite

Synthetics: No.

Imitations: None that really look like gaspeite

Treatments: None known.

34

HELIODOR

Heliodor. Yellow-colored member of the beryl family.

Heliodor is a member of the beryl family with sister stones: emerald: green, aquamarine: blue, morganite: pink, bixbite: red, and goshenite: colorless.

Source: Brazil, Madagascar, Namibia, although other sources are possible.

Chemical: Al2Be3(Si6O16) Aluminum beryllium silicate

Formation: Pegmatite dikes and granite formations

Unusual Properties: None

Colors: Light yellow to intense yellow

Wearability: Very good.

RI: 1.577 – 1.600

Birefringence: .016

Optic Character: Uniaxial Negative U-

Crystal System: Hexagonal

Specific Gravity: 2.72

Hardness: 7.5

Transparency: Transparent

Spectrum: None that is usable for identification

Special Identifying Properties and Tests: Very little on the market that will test in the beryl range and be yellow.

Synthetics: No.

Imitations: Many possible but separation based on beryl properties should be fairly easy.

Treatments: Many intense yellow beryls are treated with irradiation to improve color.

35

HELIOTROPE (BLOODSTONE)

This is a member of the chalcedony group of cryptocrystalline quartz gemstones. It derives its name from the Greek word for “sunturner.” It is morecommonly known as “bloodstone.” The name derives from a Middle Ages belief that the red areas were thought to be Christ’s blood that turned the earth to stone.

Source: Main deposits are found in India, Brazil, China, US, and Australia

Chemical: SiO2 Silicon Dioxide

Formation: Pegmatite dikes and granite formations

Unusual Properties: Unusual color mix of red and green, with occasional yellow makes heliotrope a very unusual gem material simply by

its coloring.

Colors: As shown above, dominant green with mottled red and some yellow possible.

Wearability: Very good.

RI: 1.530 – 1.539 RI is a bit lower than transparent quartz as with all chalcedonies

Birefringence: .004 +/-

Optic Character: Uniaxial Positive U+

Crystal System: Trigonal

Specific Gravity: 2.62 average

Hardness: 7

Transparency: Opaque

Spectrum: None that is usable for identification

Special Identifying Properties and Tests: None needed once you see this gem material.

Synthetics: No.

Imitations: None known.

Treatments: None known.

36

IDOCRASE

This is an unusual gemstone in that it was originally found on Mt. Vesuvius and is most likely the result of the historic eruptions of that famous volcano. It was originally called vesuvianite and you may hear that term from time to time to denote specimens that were actually found on the mountain. However, since other occurrences have been found in other parts of the world, the term idocrase has become the accepted name for the gemstone.

Source: Mt. Vesuvius, Russia, Canada, US, and others

Chemical: A very complicated calcium aluminum silicate. The chemical equation is too long to be of any service to us here.

Formation: Primary igneous rocks.

Unusual Properties: Produces a two tone, dichroic color as shown above. Basically, a brown/green color.

Colors: As shown above, dominant green / brown. But can also occur in a mottled green color called Californite (found in California), a yellow color called Xanthite, and blue color found in Norway called Cyprine.

Wearability: Good.

RI: 1.700 – 1.721

Birefringence: .005 +/-

Optic Character: Uniaxial Negative U- ….but can vary depending on the variety

Crystal System: Tetragonal

Specific Gravity: 3.36 average

Hardness: 6.5

Transparency: Transparent to Opaque

Spectrum: None that is usable for identification

Special Identifying Properties and Tests: RI is fairly conclusive. Not much else in that RI range that is double refractive.

Synthetics: No.

Imitations: Californite is sometimes confused with jade. Idocrase can be confused with demantoid garnet, and sometimes peridot, due to RI.

Treatments: None known.

37

IOLITE

Iolite

Although touted as a substitute for tanzanite, iolite actually presents a significantly unique property that should allow it to be thought of as a very unique gemstone in its own right. We are fortunate to have a large piece of rough iolite which you will see below. The optical property presented by this gemstone makes it one that virtually every collector and connoisseurhas in their collection.

Source: Brazil, Sri Lanka, India, primary sources. Others possible.

Chemical: Mg2Al3(AlSi5O18) Magnesium Aluminum Silicate

Formation: Primary igneous rocks and pegmatites.

Unusual Properties: Pleochroism is extreme with one direction of dark blue or purple… and one totally colorless. Nothing else in the gemstone world offers such a dramatic difference in directional colors that can be seen without gemological equipment of any kind.

Colors: Intense blue/purple to colorless within the same stone.

Wearability: Good.

RI: 1.530 – 1.550

Birefringence: .010 average

Optic Character: Biaxial Negative B-

Crystal System: Orthorhombic

Specific Gravity: 2.60

Hardness: 7

Transparency: Transparent

Spectrum: None that is usable (or necessary) for identification

Special Identifying Properties and Tests: Pick it up and look at it. Iolite will appear dark, intense blue or purple in one direction, and colorlessin another. as seen in the image above. Nothing else like it in the gemstone world. Should be an easy identification even for the most novice gemologists.

Synthetics: No.

Imitations: Many possible but is often thought of as an imitation of something else, itself. Used to imitate sapphire and tanzanite most often.

May be found under the names of **water sapphire**, **dichroite**, and **cordierite.**

Treatments: None known.

38

JADEITE

Although often thought of as a part of a jade group with nephrite, jadeite is actually a very different gemstone than nephrite, not only in properties but in color varieties and chemical structure. Jadeite will be higher in RI than nephrite and will offer colors far beyond those offered by nephrite. The other important factor is value. Nephrite jade occurs in many places around the world, such as boulder sized chunks underwater off the US California coast. Jadeite, on the other hand, occurs only in one location in the world, and is quite rare and expensive in comparison to nephrite. The main reason is the pastel colors and beautiful translucent forms that jadeite takes that are unlike anything else found in the gemstone world.

Source: The jadeite deposits of Myanmar.

Chemical: NaAl(Si2O6) sodium aluminum silicate

Formation: In metamorphic rock formations in the Uru Valley.

Unusual Properties: The color variety of jadeite is perhaps the most important property.

Colors: A beautiful array of colors that can include white, mauve, pink, brown, violet, black, green and many variations in between. The mostprized and expensive is the chromium rich variety of intense, translucent green known as Imperial Jade.

Wearability: Extremely good. Jadeite is a very tough, long wearing material.

RI: 1.654 – 1.667

Birefringence: .013

Optic Character: Biaxial Positive B +

Crystal System: Monoclinic

Specific Gravity: 3.30 – 3.36

Hardness: 7

Transparency: Translucent to opaque

Spectrum: Strong line at 437.

Special Identifying Properties and Tests: Chromium rich Imperial Jade will react weak red to a Chelsea filter.

Synthetics: None known.

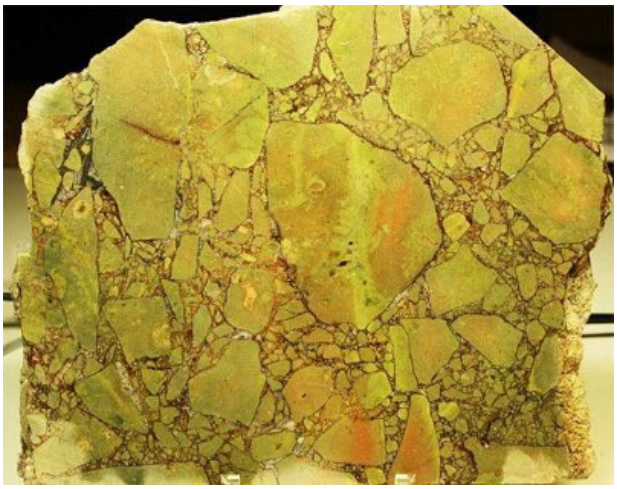
Imitations: Many possible including plastic, glass, chrysoprase, nephrite and others.

Treatments: Jadeite has been dyed to improve the color. High magnification can identify the coloring dye material.

Also, the absence of a Chelsea filter reaction for intense green Imperial Jade will be a very good indicator of a dyed green jadeite.

39

JASPER



Gekko Jasper

Source: World Wide

Chemical: Varies

Formation: Jasper forms when mineral pieces of a wide potential variety of types are compressed into a single massive rock formation. As you can see above with the Gekko Jasper, the various broken pieces of otherminerals, mostly feldspar and quartz, are crushed into pieces and, through great pressure and heat, form a single rock-like mass.

Crystal System: None. Jasper formation can be anything.

Unusual Properties: Because they are composed of a variety of minerals, jaspers can produce an amazing array of colors and formations, unlike any other gemstone.

Wearability: Excellent for jewelry items.

RI: Varies widely.

Birefringence: None

Optic Character: None

Absorption Spectra: Varies

Specific Gravity: Varies

Hardness: Varies widely.

Transparency: Opaque except in rare cases.

Special Identifying Properties and Tests: Jasper is often confused with agate. The difference is that jaspers are composed of compressedpieces of other rocks and can be easily identified by this formation.

Imitations: Many possible and many found on the market. Be careful of plastic imitations which are plentiful throughout the gemstone markets.

40

KORNERUPINE

Pronounced: “cornar-u-pine” with a short “u.” This is an unusual gemstone that is rather rare. It is named for an explorer from Greenland, and it is unusual to find in jewelry. It is a great collector gemstone. The one pictured above weighs 2.02 carats and is from the ISG gemstone study collection.

Source: Mainly from Greenland where it was originally found, SriLanka, Canada, and South Africa.

Chemical: Mg4Al2((O/OH)2/BO4(SiO4)4) Magnesium aluminum borate silicate

Formation: Primary Igneous Rocks
Unusual Properties: None
Colors: Green with brown overtones
Wearability: Very good.
RI: 1.665 – 1.682
Birefringence: .013
Optic Character: Biaxial Negative B-
Crystal System: Orthorhombic
Specific Gravity: 3.30 avg.
Hardness: 7
Transparency: Transparent
Spectrum: None that is usable for identification
Special Identifying Properties and Tests: None
Synthetics: No.
Imitations: Many possible
Treatments: None known.

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KUNZITE

This interesting gemstone was first discovered by Mr. George Kunz in 1902, and therefore named after him. Kunzite is a variety of spodumene and brings with it a variable set of restrictions as a gemstone. First, it is sometimes referred to as the Midnight Stone. Why? Because more have a strong tendency for the pink color to fade when exposed to sunlight for an extended period of time. Also, the stone is fairly brittle with perfect directional cleavage, and is strongly pleochroic…meaning it has to be cut very carefully to bring out what is often a very light pink color. Kunzite was very popular in the 1980's, but the popularity waned when the color fading problem become widely known. There are a lot of kunzites out on the

market, however, and gemologists should be aware of the gemstone's properties and requirements of handling.

Source: Mainly from United States, Brazil, and Madagascar.**Chemical**: LiAl(Si2O6) Lithium aluminum silicate **Formation:** Pegmatite dikes

Unusual Properties: None

Colors: Very light to intense pink

Wearability: Fair.

RI: 1.660 – 1.680

Birefringence: .016

Optic Character: B +

Specific Gravity: 3.17 + –

Crystal System: Monoclinic

Hardness: 6.5 + –

Transparency: Transparent

Special Identifying Properties and Tests: Strong pleochroism possible. Strong reaction to fluorescence.

Synthetics: None known

Imitations: Many possible.

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KYANITE

Until 2001, kyanite was mainly considered a collector's stone, owing to the fact that it was not available in the market except in rare instances. And even then, the color tended to be mottled and uneven. In 2001, however, Bear Williams of Bear Essentials, a gemstone dealer in the USand good friend of the ISG, announced the discovery of a major deposit of kyanite in Nepal. This material was not only more uniform in color, but the deposit was large enough to supply commercially viable supplies to establish a market. You can see an example of this kyanite in the image above. This is a specimen donated to the ISG collection by Mr. Williams in 2001.

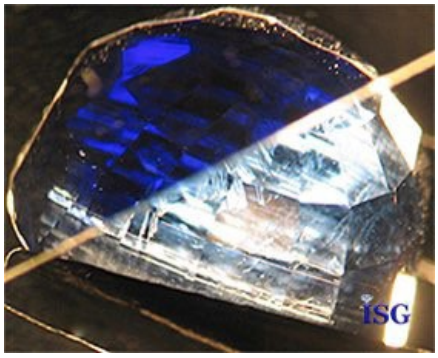
Source: Mainly from Nepal, but additional deposits can be found in Brazil, Kenya, the United States, Austria, and other locations.

Chemical: Al2O(SiO4) Aluminum silicate

Formation: In metamorphic rocks. Forms in prismatic blades as seen in the image below.

Unusual Properties: None.

Colors: Medium to Dark Blue Fair. Has directional hardness properties (see below) that cause cutting to be difficult and wearing also. Best set necklaces and earrings.



Kyanite through London Dichroscope.

RI: 1.715 – 1.732

Birefringence: .017

Optic Character: B – Biaxial Negative

Specific Gravity: 3.67 + –

Crystal System: Triclinic

Hardness: 6.5 + – perpendicular to "C" axis, 4.5 parallel to axis. Directional hardness creates difficulty in cutting.

Transparency: Transparent

Special Identifying Properties and Tests: Strong pleochroism possible. Strong red reaction to fluorescence.

Synthetics: None known

Imitations: Many possible.

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LABRADORITE

It is rare for a gemstone to lend its name to a gem phenomenon. In fact, only one has ever done that. And the stone: Labradorite….and labradorescence. This unusual gemstone gets its name from the Canadian peninsula of Labrador where it was first found in 1770. It has a unique optical property that is so unusual, that no other gemstone offers exactly thesame property except…labradorite.

Source: Mainly from Canada, but also found in the US, Mexico, and Russia.

Chemical: Na(AlSi2O8)CA(AL2SI2O8) a sodium aluminum silicate. It should be noted that the feldspar group of gemstones is composed of the **Sodium Feldspars** and the **Potassium Feldspars.** Each is very similar in virtually all properties except for this isomorphous replacement series within the group. Sometimes moonstone is confused with labradorite,but moonstone is a potassium feldspar while labradorite is a sodium feldspar. .The importance of this is that there is a type of labradorite on the market that is being sold as rainbow moonstone…which is actually a form of labradorite. And the term rainbow moonstone is an improper name to callthis version of labradorite. There is a rare formation of labradorite/moonstone which is a combination of the two types of feldspars,but it is quite rare.

Formation: Igneous rocks

Unusual Properties: Labradorescence.

Colors: Dark brown with rainbow colors on the surface. The color is like a sheen of oil on water, with rainbow colors playing off the surface of the stone.

Wearability: Very Good

RI: 1.560 – 1.568

Birefringence: .008

Optic Character: B + Biaxial Positive

Specific Gravity: 2.70

Crystal System: Triclinic

Hardness: 6.5

Transparency: Opaque normally. Rarely transparent**.**

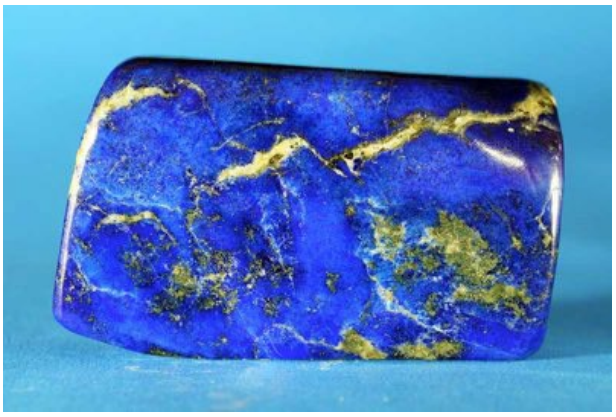
Special Identifying Properties and Tests: The sheen of labradorescence is unmistakable to the trained gemologist. A rare type with

a full rainbow of colors called spectrolite is available on the market. Labradorite can be distinguished from moonstone by its higher SG and RI.

Synthetics: None known

Imitations: None that are convincing.

LAPIS LAZULI



Lapis Lazuli

A rare gemstone becoming rarer by the day. Lapis Lazuli has a long history in the gemstone world…and beyond. Used as jewelry items since the Middle Ages, lapis lazuli was also used as a paint coloring element during the Renaissance in many famous paintings. It is properly classified as a rock…and not a mineral.

Source: The finest quality of purest blue comes from the West Hindu Kush mountains of Afghanistan. Other important sources include Russia and Chile; however, these are known for heavy content of pyrite inclusions that takes away from the beauty and value.

Chemical: Na8(Al6Si6O24)S2 Sulphur based rock with sodium aluminum silicate. Main constituent is lazurite.

Formation: Igneous rocks

Unusual Properties: None.

Colors: Dark to medium light blue. Sometimes with yellow pyrite inclusions, and the lesser quality lapis lazuli will have varying degrees of white calcite running through it.

Wearability: Good. Although it is quite porous and is susceptible to acids and other liquids that can permeate the stone with negative results. Should not be cleaned in regular jewelry type cleaners containing ammonia.

RI: 1.50 average. Due to the fact that this is a rock with variable constituents the RI can vary from specimen to specimen

Birefringence: None

Optic Character: None

Specific Gravity: 2.60 average but can vary widely due to variable amounts of minerals

Crystal System: Cubic but very rare

Hardness: 6

Transparency: Opaque

Special Identifying Properties and Tests: Presence of pyrite very helpful but there is a type of synthetic that also puts pyrite in an imitation type. Therefore, the presence of pyrite cannot be diagnostic. RI is usually all that is required to determine lapis lazuli. Chelsea Filter is diagnostic as natural lapis lazuli will have a very faint red glow under the Chelsea filter that imitations will not offer. Also, be aware that lapis lazuli is often dyed to improve the color as seen above. A cotton swab and fingernail polishremover or acetone will quickly rub some of the dye off, making thetreatment easy to detect.

Synthetics: Yes. There is a synthetic on the market that is more imitation than true synthetic. For more on this see the Created and Treated

Gemstones course.

Imitations: Several on the market. Careful RI and Chelsea filter should separate them quite easily, however.

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LARIMAR (PECTOLITE)

A rare volcanic gemstone found primarily in the Dominican Republic in the Caribbean, **larimar** is unlike anything you have encountered in the gemstone world. It is relatively new on the gemstone market and is noteven listed in some text books. Not only does it offer a rather romantic sounding name, but the very appearance of soft mottled blue colors allows this gemstone to make beautiful jewelry items that wear exceptionally well. You may find it listed in some text books as **pectolite**. But that is not a veryromantic name. So those of us who have lived and worked in the Caribbean

islands prefer the name **Larimar**! It is dug by hand in very crude pit mines around the mountains of the Dominican Republic.

Source: Primary source in the Dominican Republic. Other sources have been reported in Canada but the Canadian stones are of a greyish white and not the beautiful blue of the Dominican Republic.

Chemical: HNaCA2(SiO3)

Formation: Igneous rocks

Unusual Properties: None.

Colors: A wonderful soft blue that runs from dark to light, with mottled veining of lighter blue to white color running through it.

Wearability: Good.

RI: 1.59 – 1.63

Birefringence: None

Optic Character: None

Specific Gravity: 2.74

Crystal System: Monoclinic but rare in crystals

Hardness: 5

Transparency: Opaque

Special Identifying Properties and Tests: None really needed. Thereis nothing on the market that looks like fine quality larimar except, perhaps, some plastic imitations.

Synthetics: No.

Imitations: Plastic and glass possible. But should be easy identification due to RI and SG.

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MALACHITE

Malachite

The nice thing about malachite is that no two pieces will ever be quite the same….even when cut from the same stone. Malachite is an oxide of copper, forming when oxygen combines with copper to cause it to bubble up. You can see how the layering of the formation creates the lines that run through the stone when it is cut. Malachite is a sister stone to azurite and sometimes forms in conjunction with it. It is a beautiful gemstone that has been used in jewelry and carved artwork for centuries.

Source: Primary source is Democratic Republic of Congo (Zaire), along with Australia, Chile, the US, and others.

Chemical: CU2(OH)2CO3

Formation: Along veins of copper ore.

Unusual Properties: A very unusual color scheme with veins of dark to light green.

Colors: A wide array of greens from dark to light in vein formations along the bubble planes of the formation.

Wearability: Fair to good. A bit soft for a ring but wears nicely in necklaces and earrings.

RI: 1.655 – 1.909

Birefringence: .254

Optic Character: Biaxial Negative B-

Specific Gravity: 3.80 average

Crystal System: Monoclinic but rare in crystals

Hardness: 4

Transparency: Opaque

Special Identifying Properties and Tests: None really needed. There is nothing on the market that looks like malachite.

Synthetics: No.

Imitations: None that are really viable.

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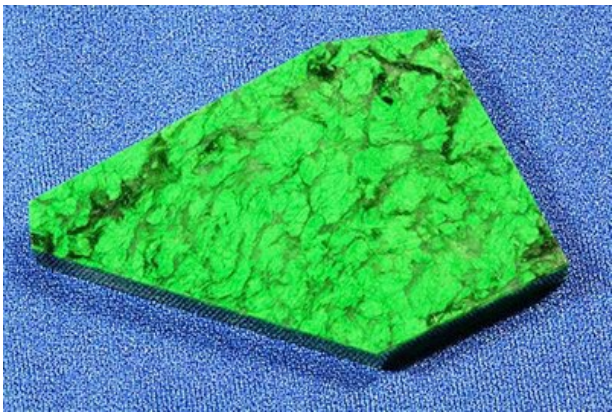
MAW SIT SIT



This is one of our favorite gemstones for a number of reasons. One is the name. It is sort of fun to pronounce, and if you ever want to test just how much someone knows about colored gemstones…ask them about maw sit sit. If they say: HUH? You know you have someone still stuck in the main stream of the colored gemstone world. Second, it is pretty. A beautiful greencolor that looks like fine quality jade, which makes sense since one of the constituents that make up maw sit sit is jadeite. It has been pretty rare on the market, but I am seeing more and more of it as time goes by. Awonderful example of what the gemstone world can offer with an unusual name from a small place that no one has heard of…until they named a gemstone after it.

Source: From a place called Maw Sit Sit in upper Myanmar. Maw sit sit was first identified by the late Dr. Eduard Gubelin in 1963 and named after the village close to the site where it was found.

Chemical: Combination of minerals not fully understood at this writing. But does have a major component of jadeite as can be seen in the image above.

Formation: A metamorphic rock that was formed when higher pressure changed a formation of igneous rocks. The formation had a lot of chromium-based minerals such as chromite and chrome rich jadeite, which accountsfor the color.

Unusual Properties: None.

Colors: A very unusual color scheme of intense green with mottle black spots.

Wearability: Good.

RI: 1.52 – 1.54

Birefringence: N/A

Optic Character: N/A

Specific Gravity: Range from 2.46 to 3.15 has been reported

Crystal System: Aggregate

Hardness: 6.5 average

Transparency: Opaque

Special Identifying Properties and Tests: None really needed. There is nothing on the market that looks like maw sit sit.

Synthetics: No.

Imitations: None that are really viable.

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MOLDAVITE

An out of this world event is believed to have created this strange gemstone. Moldavite is the name given to a type of fused silicon glass thatis found where meteorites have impacted the earth and transformed silicon rich rocks. The stones carry many properties of glass and are found in known impact areas of meteorites. It is named for Moldau, Czech Republic from which the first known discovery was made.

Source: Potentially worldwide, but most notably the Czech Republic, Australia, and the USA.

Chemical: Si2O2 Silicon Dioxide

Formation: Impact melting of host rock by meteorites.

Unusual Properties: Because of their rarity, moldavites have become a collector's item. They are generally small, rarely averaging more than 1 inch before cutting. So, a large moldavite would be fairly rare and probably quite expensive. Being able to separate true moldavite from plain old green glass will be an important property for gemologists to learn.

Colors: Green to brownish green

Wearability: Good

RI: 1.48 – 1.50 range

Birefringence: None

Optic Character: None

Specific Gravity: 2.34 average

Crystal System: None…… Amorphous

Hardness: 5 1/2

Transparency: Transparent

Special Identifying Properties and Tests: RI and SG should pretty well separate moldavite from any other gemstone. Not much other thanglass in that area and in this color. But you need to be aware of green glass counterfeits. Most green glass will show the characteristic gas bubbles and swirl lines that moldavites do not offer.

Synthetics: None.

Imitations: None.

49

MOONSTONE

This is a sister stone to the labradorite we studied earlier. Moonstone is a potassium-based member of the feldspar group and offers the gem phenomena of adularescence….the reflected light that appears to float around the stone as it is rotated. You can see the silvery sheen of the adularescence in the image above.

Source: Most important deposits in Sri Lank, Brazil, and India.**Chemical**: K(AlSi3O8) potassium aluminum silicate

Formation: Igneous rocks and formations

Unusual Properties: Adularescence or moonstone effect.

Colors: Usually colorless to white in color.

Wearability: Good.

RI: 1.520 – 1.525

Birefringence: .005

Optic Character: Biaxial Negative B-

Specific Gravity: 2.58

Crystal System: Monoclinic

Hardness: 6.5

Transparency: Transparent to translucent

Special Identifying Properties and Tests: The adularescence of moonstone is the most prominent indicator.

Synthetics: No.

50

MORGANITE

This is a sister stone to emerald, aquamarine, and heliodor….in other words, the beryl family. Morganite is usually seen in very light colors as you see above, but can occur in rare occasions in rather dramatic colors. Named after the famous US gem collector, J.P. Morgan, morganite is the pink to violet variety of beryl. Source: Most important deposits in Brazil, Sri Lank, and US (California).

Chemical: Be3Al2(Si6O18) beryllium aluminum silicate
Formation: In pegmatite formations
Unusual Properties: None
Colors: Usually, light pink to violet as seen above.
Wearability: Good.
RI: 1.570 – 1.585
Birefringence: .007 +/-
Optic Character: Uniaxial Negative U –
Specific Gravity: 2.85 average. Higher than most of the beryls
Crystal System: Hexagonal

Hardness: 7.5
Transparency: Transparent
Special Identifying Properties and Tests: None
Synthetics: None known at this time
Imitations: Plastic and glass imitations possible.

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MYSTIC TOPAZ

Source: Brazil is the major source for the starter topaz crystals. But other sources include Australia, United States, Zimbabwe, Nigeria, and others.

Chemical: Al2(SiO4)(F,OH)2 plus unknown coatings.

Formation: Mystic Topaz is a coated gemstone. It is not natural. The formation uses natural topaz crystals that are heavily coated to create the "mystic" type coloring. The coating is not permanent and is, in fact, very fragile to set and wear.

Unusual Properties: Unusual neon colors.

Colors: As seen above, almost any color is possible, with rainbows of colors very often found. These colors are totally unnatural for topaz but do make for interesting viewing.

Wearability: Extremely fragile.

R**I:** Due to the coating material, refractive index readings will vary greatly and be of no help for identification.

Birefringence: None

Optic Character: Usually, nonvisible due to coating.

Specific Gravity: 3.53 average

Crystal System: Orthorhombic

Hardness: 8 average for topaz, but the coating has a hardness of less than 1.

Transparency: Transparent

Special Identifying Properties and Tests: The colors of mystic topaz are the "tell." Natural topaz will never have the neon rainbow colors without the special "mystic" coatings.

Synthetics: None known or anticipated. The chemical equation of topaz is too complicated to synthesize at this time.

Imitations: None required as this is a treated gemstone.

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NEPHRITE JADE

Canadian nephrite jade from the Jade West mines in Canada.

What color is it?: The nephrite variety of jade will be medium dark green with mottled black streaks running through it as shown above and below.

What is the story behind this gemstone?: The term **nephrite** is used to distinguish a gemstone that is associated with **jadeite** as being part of the **jade family**. Actually, they are two different stones with some distantly similar properties, but due to their similarities in color and use in carvings in China they have come to be related to each other if in name only.

However, **nephrite** does have some properties that **jadeite** will not have. Particularly in rarity and durability. Nephrite jade is found in huge boulders off the coasts of California and Western Canada. Jadeite is not nearly as plentiful. And nephrite is more durable, which means it is used more widely for carvings.

Can I wear it every day?: Absolutely. **Nephrite** is one of the longest wearing of any gem material.

Is it expensive?: Not really. Fine quality carvings such as the bear above will cost in the $50.00 to $100.00 range. The nephrite itself is only part of the issue of price, however. Fine quality carvings by true artists will lend additional cost to the item...and rightly so.

Is it a birthstone?: No.

What do I need to know before going shopping?: Remember that there are several other gemstones out on the market that will imitate nephrite. The problem is that they are not as durable. Be sure and stay witha reputable dealer or carver when shopping for items made of nephrite. Remember that the artistic work done on the item of nephrite may dictatethe price more than the gemstone itself.

Source: Canada, United States, Mexico, and Australia are major world producers. Other sources world-wide.

Chemical: $Ca_2(MgFe)_5(Si_4O_{11})_2$ a calcium magnesium, iron silicate.

Formation: Igneous rocks

Crystal System: Monoclinic although rarely found as crystals

Unusual Properties: Ability to take a carved edge. There is a story told at the GIA about an old jewelry store that burned. The only objects that survived the fire were the expensive nephrite carvings, even though the expensive nephrite jade carvings were on the top shelf and fell all the way to the floor. The toughness of the stone allowed them to survive. Excellent for tough wear and tear by any consumer.

RI: 1.600 - 1.627

Birefringence: .027

Optic Character: B -

Specific Gravity: 2.90 + -

Hardness: 6.5 but toughness is much higher

Transparency: Generally opaque

Special Identifying Properties and Tests: Spectroscope absorption at 509 is diagnostic. RI, SG, and spectrum should be diagnostic from most imitations.

Synthetics: None known.

Imitations: Many possible including amazonite, aventurine, bowenite, californite, and chrysoprase, to name a few.

OBSIDIAN

Source: World wide

Chemical: Si (natural silicon glass)

Gemological Properties: Varied Widely due to glass alterations in formation.

Crystal System: None

Formation: Forms in volcanic lava flows that cool quickly. Obsidian is a natural formation of glass with a wide variety of colors and compositions possible.

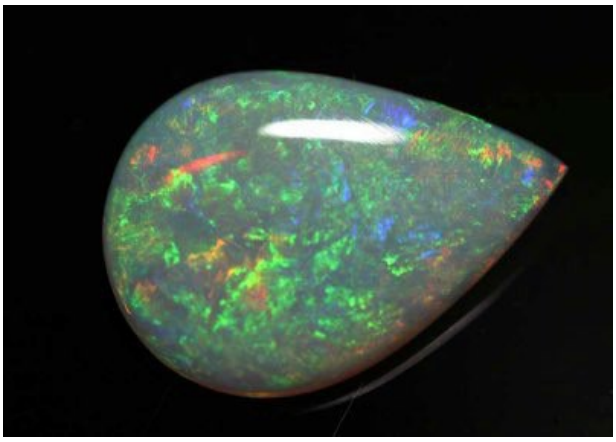
Colors: Obsidian can occur in a wide array of colors.

Unusual Properties: S*nowflakes* can occur in obsidian. These are caused when the natural glass degenerates around areas that you see as

snowflakes.

54

OPAL



Australian Opal

Opal is a gemological study all its own that can last a lifetime. There are many classifications of opal, far more than we can go into here. You need to know the basics of how to identify opals as natural, from a gemological standpoint. But if you are going to buy and sell opals as a dealer, you will need a lot of experience in the valuation of opals, and you will need a lot of experience in the wide varieties of types, grades, and colors of opals because small variations in color or formation can account for wide variables in value. So, do not think you are going to be able to go to **The Guide**, or someother industry publication, and get enough pricing information to appraise afine quality opal. It just will not happen. Opal appraising should be done by

those who have heavy experience in the opal markets, and/or have a lot of friends that deal in opals.

It should be noted that opals are considered part of the quartz group of gemstones by some authorities. Mainly because it is silicon dioxide, just like quartz. Opals consist of a significant amount of water, about 15% wateris the reported average, but can run as high as 30% water. Given the factthat opal does not have a crystal structure, (it is **amorphous)**, placing it in the quartz group would be based on chemical composition only. It shares few other properties with quartz.

You should note that the term **fire opal** does not mean an opal with a lot of fire. It is a specific name for a variety of opal that is translucent to semi-transparent, yellow to orange in color, and is normally faceted…although can be cut en cabochon. I hear many, many jewelers incorrectly refer to nice quality crystal opals as "fire opal." This is wrong and will tell you that the person does not know opals. (see Fire Opal in this eBook)

Source: Most important deposits in Australia, Brazil, and US (Nevada).

Chemical: SiO2 with H2O

Formation: Opals occur due to silicon rich ground water seeping into voids left normally by decaying ancient trees. Although other types ofcreated underground voids can cause opalization to occur, the decaying forest is the place where most opals form. Which should tell you something about climate change as the world's best-known opal field is in the middle of what is now a desert in Australia at Lightning Ridge. But as the celluloseof the tree wood decays, it leaves empty cells in the wood. As the silicon- rich water seeps down into the void, it eventually dries out and leaves the silicon behind to form opals. Some of the water is retained by the silicon dioxide…which is why opals contain so much water. And the silicon forms as small rows of round spheres that create **a play of color**, a diffraction of light that is the same effect as a diffraction grating spectroscope.

Opal can also occur in cavities in the rock where the water can congregate and dry slowly…allowing the silicon to form the opal.

Unusual Properties: Endless. Every opal is unique. And the color and pattern possibilities are endless. Opal do occur showing asterism and chatoyancy.

Colors: Endless.

Wearability: Fair. Opals have a hardness that averages 6 on the Mohs Hardness Scale. It makes better necklaces and earrings than rings as far as long-term wear is concerned.

RI: 1.44 – 1.46

Birefringence: None

Optic Character: None

Specific Gravity: 2.10 average but can vary widely based on the amount of water contained in the stone.

Crystal System: Amorphous: no crystal structure

Hardness: 6 average

Transparency: Translucent to Opaque

55

PEARLS

What color is it?: Take your pick. Today pearls are being cultured in virtually every color of the rainbow.

What is the story behind this gemstone?: Pearls were first successfully cultured in Japan around 1921 by Mr. Kokichi Mikimoto.Before that time only natural pearls were available, and the prices were veryhigh and supplies sporadic at best. Today, cultured pearls are available in virtually any size, shape, and color that you can imagine. There are ***akoya*** cultured pearls from Japan, ***freshwater*** cultured pearls most of which are coming out of China, and ***South Sea and Tahitian*** pearls coming from

Tahiti and Australia that are shown below. The story of pearls is very long. And I strongly recommend consumers to find a qualified independent professional retail jeweler who sells a lot of different types of pearls in order to get the whole story...which we do not have room for on this page.

Can I wear it every day? Yes. But be sure and wait to put your pearls on until after you put all that hair spray and perfume on. Hair spray and perfume are what causes pearls to turn off color. Sticks to the pearl and ***cannot be removed.*** So, wear them every day. But put them on as you walk out the door.

Is it expensive? Very much yes...and very much no. Cultured pearls today range from very expensive for fine quality matched strands, to fairly cheap for the strands sold by the discount stores. Basically, with pearls as with anything else, you get what you pay for. And nobody sells nice quality pearls for cheap prices.

Is it a birthstone?: Yes, for June Brides.

What do I need to know before going shopping?: Read this very carefully if you would please. Cultured pearls increase in quality the longer they stay in the oyster. The longer they stay, the thicker the ***nacre layer*** that the oyster puts on the pearl. The thicker the ***nacre layer***, the more expensive the pearl. Now, it can be difficult for a consumer to tell just how thick a nacre layer is. Gemologists can tell because we can see down the drill hole and see how thick the nacre layer is. Here is the problem. A pearl that has not been in the oyster very long will be hard to identify from one that has been in for a long time, to the untrained eye. Which is how some of these discount stores can claim they are selling fine quality strands of cultured pearls for $600.00 that are equal to one being sold by another jeweler for $2000.00. The problem is, what they are not telling is that the $600.00 pearls have very thin layers of ***nacre,*** which means that after only a few months of wear someone could end up with white beads rather than cultured pearls, because all the ***nacre*** will wear off. If you are buying and/or selling pearls,

be aware that nacre layer and quality is the real value determination, and there are many pearls on the market with little of either.

Source: Japan, China, Mexico, United States, Venezuela, and other markets

Chemical: Calcium carbonate in the form of aragonite layers

Formation: Various species of oyster

Crystal System: None

Unusual Properties: Orient

GEMOLOGICAL INFORMATION

Three South Sea Tahitian Pearls of creme, grey, and black colors. All measure approx. 13mm each.

RI: 1.530 - 1.685

Birefringence: .155

Optic Character: Organic

Specific Gravity: 2.70 + -

Hardness: 3-4

Transparency: Opaque

Special Identifying Properties and Tests: The old "tooth rub" where you rub the pearl on the lower cutting edge of your tooth. A scratchy or

gritty feeling will generally indicate a cultured or natural pearl. Just be sure and brush your teeth if you are doing this test in front of a customer.

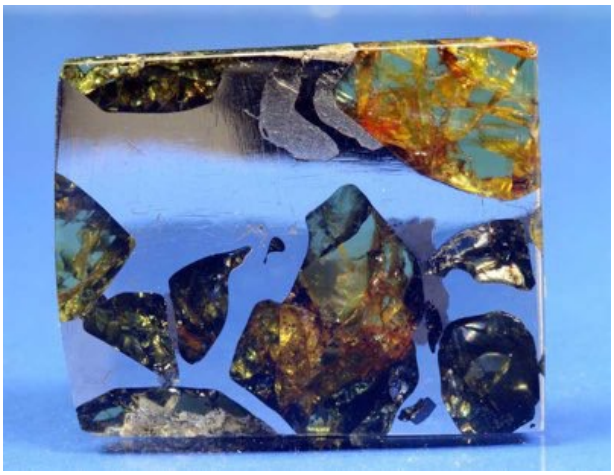
Synthetics: None

Imitations: Many and varied

56

PERIDOT

Peridot is pronounced: “pear i’ doe.” With the “t” silent. That is probably the first question you will get about peridot. It forms in primary igneous rocks and can be found virtually worldwide. A couple of interesting side notes about peridot…. They are rare in large sizes. One of the largestperidots on record is only 310 carats….small by most gemstone standards. Anything of 3.00 carats and over is considered a major specimen of peridot,and…they are found in meteorites.



Quite fascinating when you consider that these are peridots from outer space. as seen above with these peridot crystals in a meteorite. Makes you wonder what else is out there floating around the universe. Peridot is also called olivine in some parts of the world and is a member of the forsterite group of gemstones. Peridot is also an indicator stone for diamonds as it is often found in conjunction with diamonds.

Beautify necklace of peridot gemstones.

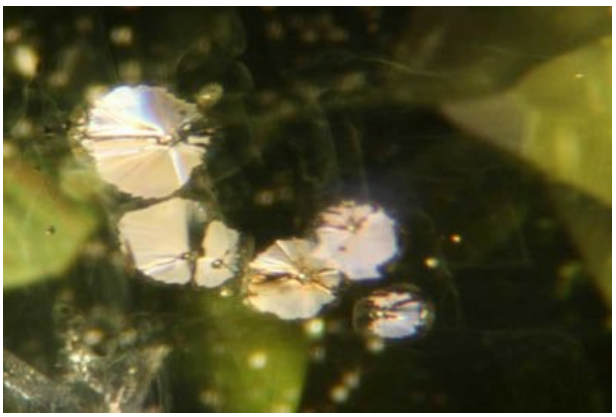
Source: Igneous rocks found in many parts of the world. Some of the most fun are the volcanic rocks on the beaches of the US island of Hawaii.

Chemical: Mg_2SiO_4, Fe_2SiO_4

Formation: Primary igneous rocks.

Unusual Properties: None. Rare to find with chatoyancy or asterism.
Colors: A soft green to yellow green.
Wearability: Good.
RI: 1.654 – 1.690
Birefringence: .036 One of the largest ranges of RI you will find.
Optic Character: Biaxial Positive B +
Specific Gravity: 3.30 average
Crystal System: Orthorhombic
Hardness: 7 average
Transparency: Transparent

Special Identifying Properties and Tests: Two important features of peridot. First is the soft appearance of peridot. This is due to extreme doubling of back facets due to very high birefringence. This gives peridot a soft color appearance to the wearer. Also, it is rather common for peridot to offer **lily pad inclusions** as seen below. These are natural inclusions in the stone that appear as lily pad formations inside the stone. Very rare to find these in green stones of anything other than peridot. Both of the above are key sign posts for identification of peridot using just a loupe.



Classic lily-pad inclusions in natural peridot.

Magnetism: Due to the high content of iron in peridot, it is very stronglydrawn to a magnet. By floating it on a small piece of Styrofoam in a bowl of

water the peridot can be pulled across the water with a magnet. This is one of the special properties of peridot.

Synthetics: Possible. There is a type of synthetic forsterite on the market that can give you problems. Look for the lily pad inclusions. That will be diagnostic with all other factors being equal.

Imitations: Plastic and glass imitations possible. Others are possible butthe facet doubling and lily pad inclusions should provide you with an easy separation.

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PETALITE

Here is one you will not see much on the market, but they will occasionally be found. It is rather rare, and not really a major player in the gemstone world. But you will need to have petalite in your gemstone reference library.

Source: Mainly in Australia and Brazil, but other sources may be available.

Chemical: (Li,Na)(Al2Si4O10) Lithium Sodium Aluminum Silicate

Formation: Primary igneous rocks.

Unusual Properties: None. Rare to find with chatoyancy

Colors: Colorless to yellowish pink.

Wearability: Fair
RI: 1.502 – 1.518
Birefringence: .016
Optic Character: Biaxial Positive B +
Specific Gravity: 2.40 average
Crystal System: Monoclinic
Hardness: 6 average
Transparency: Transparent
Special Identifying Properties and Tests: None
Synthetics: None

58

PIETERSITE

Source: China and South Africa

Chemical: A combination of quartz structures, primarily tiger-eye and compressed jasper.

Unusual Properties: Color combinations and some chatoyancy make this gemstone very unique.

Colors: Include dark brown, red, yellow, and more.

Wearability: Excellent.

RI: 1.544 - 1.543 (same as quartz)

Birefringence: .010

Optic Character: Uniaxial Positive (U+)

Specific Gravity: 2.74 average

Crystal System: Trigonal

Hardness: 7 average

Transparency: Opaque

Special Identifying Properties and Tests: None required if the colors are considered.

Synthetics: None

59

PREHNITE

Prehnite is not a new stone on the market but is one you have probably not seen very often. Recent finds in China and Australia have greatly increased the availability of prehnite. It is usually cut as cabochon.

Source: Mainly in Australia and China.

Chemical: Ca2Al2 ((OH)2/Si3O10) Calcium Aluminum Silicate

Formation: Primary igneous rocks.

Unusual Properties: None. Rare to find with chatoyancy but they do exist.

Colors: Green to yellowish green to brownish yellow.

Wearability: Good. Sensitive to heat so care should be taken when setting prehnite in a jewelry item where soldering is being done after the setting work.

RI: 1.61 – 1.64
Birefringence: .030
Optic Character: Biaxial Positive B +
Specific Gravity: 2.90 average
Crystal System: Orthorhombic
Hardness: 6 average
Transparency: Transparent to Opaque
Special Identifying Properties and Tests: None
Synthetics: None
Imitations: None.

60

QUARTZ

Intergrowth of clear quartz crystals is often used to make beads and "rock crystal" jewelry items.

There are many types of quartz in the world of gemstones. From amethysts and citrine to the entire chalcedony group of cryptocrystalline quartz. However, here we are going to be talking about…just quartz. Sometimes known as rock crystal. The pure variety of quartz that is without color, is transparent, and is the original specimen in just about everyone's gemand/or mineral collection. The crystal ball used by fortune tellers is made ofquartz. The original crystal stemware drinking cups were made of rock crystal quartz.

Quartz crystals can occur in huge sizes as shown in the image below….allowing for many wonderful carved items that have adorned homes for centuries. Of course, quartz crystals make beautifuljewelry items owing to some of the wonderful variations that are available due to the type of inclusions you find.

Source: Around the world, and probably in your back yard. Silicon is one of the most prevalent materials on the surface of the earth, and quartz isthe main place you will find it. Quartz can be found on virtually every continent of the world. However, large transparent crystals are most often found in Brazil.

Chemical: SiO2 Silicon Dioxide

Formation: Pegmatite dikes for large cuttable crystals

Unusual Properties: None. Although the variety of inclusions can provide some very unique gemstones.

Colors: Clear and colorless.

Wearability: Good.

RI: 1.544 – 1.553

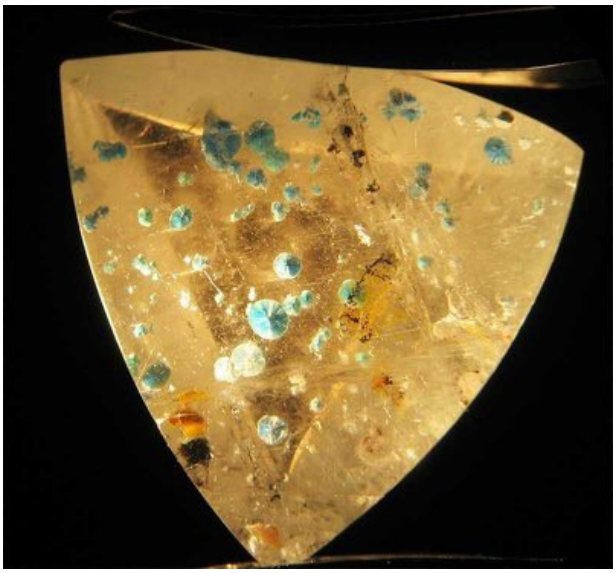
Birefringence: .009

Optic Character: Uniaxial Positive U +

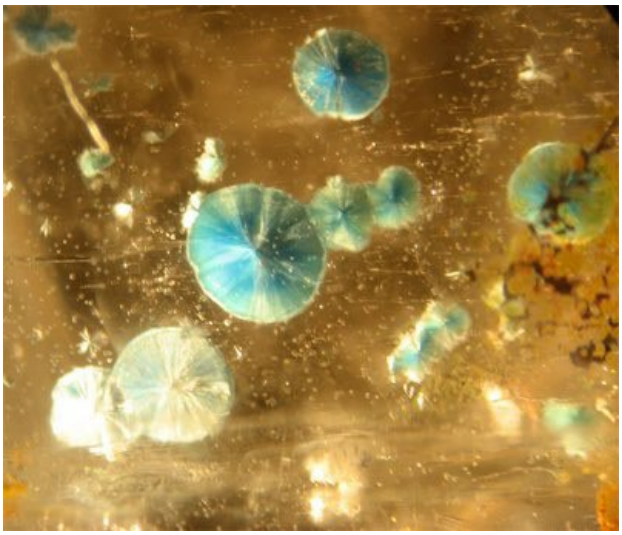
Specific Gravity: 2.65

Crystal System: Trigonal

Hardness: 7



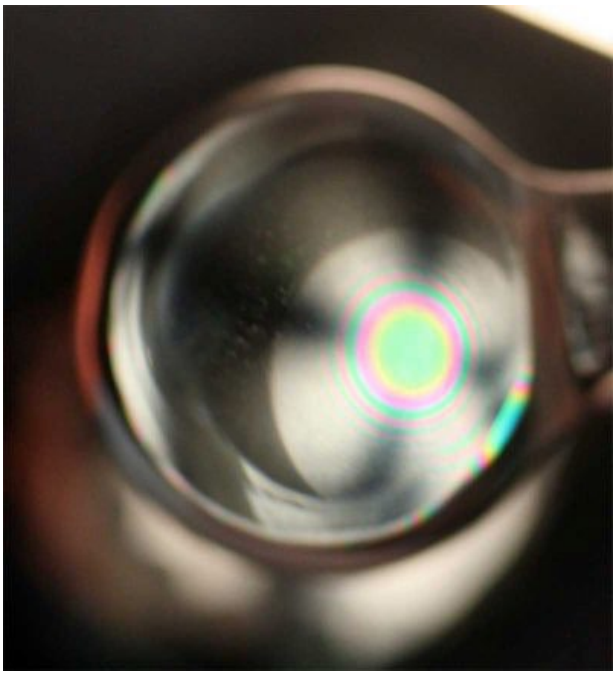
Faceted quartz with gillilite crystals included.



High magnification look at the quartz above.

Transparency: Transparent to translucent

Special Identifying Properties and Tests: Bulls-eye interference figure seen through a conoscope using a polariscope is diagnostic as seen below.



Synthetics: Yes. Quartz is synthesized to make electronic components. However, most of the synthetics you will find on the market will be of the amethyst and citrine variety. You will rarely encounter synthetic rock crystal type quartz (colorless).

Imitations: Many possible but separation is quite easy with the bull's-eye interference figure.

61

RED BERYL (BIXBYTE)

We include the red beryl in our study because there is finally enough of this material on the market to create a viable commercial market for the stone. Found in the US as its only source, this variety of beryl is sometimes referred to as bixbite, and sometimes as a “red emerald,” owing to the fact that it is a red variety of beryl. But red beryl is the term most correct to referto this gemstone as bixbite is not a very recognized name, and leaves open many questions to many consumers regarding its value. It is rare and canbe quite expensive in larger sizes.

Source: Thomas Mountains, Utah, United States

Chemical: BeAlSiO2 colored by manganese

Formation: Pegmatite dikes for large cuttable crystals

Unusual Properties: None.

Colors: Red.

Wearability: Good.

RI: 1.570 – 1.579

Birefringence: .009

Optic Character: Uniaxial Negative U –

Specific Gravity: 2.65 average

Crystal System: Hexagonal

Hardness: 7.5 average

Transparency: Transparent

Special Identifying Properties and Tests: Nothing exceptional needed. No other gemstone is going to give you beryl reactions in this red color.

Synthetics: Yes. Produced in the lab using the hydrothermal method.

Imitations: Many possible including glass and plastic.

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RHODOCHROSITE

rhodochrosite cut "en cabochon"

One of the more interesting gemstones on the market, which does not get as much respect as it perhaps should. The massive form as seen above is the most common form of rhodochrosite. This is due to formation as stalagmites in ancient silver mines in South America. However, there are also some wonderful transparent crystals that are faceted into cut rhodochrosites available on the market. These are mostly from a mine in Colorado in the US, as well as Argentina.

Source: Argentina and United States

Chemical: MnCo3 / manganese carbonate

Formation: In stalagmites due to silver ore deposition out of seeping water, and in primary igneous rocks as transparent crystals.

Unusual Properties: Extreme birefringence.

Colors: Red to pinkish red in transparent. Mottled red/white in the massive formations.

Wearability: Fair. Is rather soft so it makes necklaces better than rings.

A matrix of rhodochrosite crystals above left.

RI: 1.600 – 1.820

Birefringence: .22 (one of the highest birefringence numbers you will ever see)

Optic Character: Uniaxial Negative U –

Specific Gravity: 3.50 average (will vary based on formation)

Crystal System: Hexagonal

Hardness: 4 average

Transparency: Transparent to opaque

Special Identifying Properties and Tests: Nothing else is going to give you the mottled red/white formation (see below), or the extremely high birefringence of rhodochrosite.

Synthetics: None
Imitations: None that are plausible.

RHODONITE

One of the lesser seen gemstone materials, rhodonite is used for beads and cabochon jewelry items. We have a limited number of images at this time simply due to there not being a lot of rhodonite out there on the market at this time. The image above is a slice of rhodonite from the Tucson show a few years ago. The color is rose/red with black mottling. You can also see some of the yellow mottled color in the upper right corner of the slab.

Source: Mainly from Sweden, US, Canada, Australia, and South Africa.

Chemical: MnSi03 / manganese silicate

Formation: In primary igneous rocks, as transparent crystals.

Unusual Properties: None.

Colors: Red to pinkish red with black veining or mottling.

Wearability: Fair. Is rather soft so it makes necklaces better than rings.

RI: 1.733 – 1.744

Birefringence: .011

Optic Character: Biaxial Positive B +

Specific Gravity: 3.50 average (will vary based on formation)

Crystal System: Triclinic

Hardness: 6 average

Transparency: Opaque, although a transparent variety has been reported.

Special Identifying Properties and Tests: Nothing else is going to give you the mottled red/black formation.

Synthetics: None

Imitations: Many possible.

64

RUBY

Although a part of the corundum group of gemstones with sapphire, the name ruby is properly applied strictly to the pure red variety of corundum. The problem is, where do you draw the line of how pure red is defined? Many rubies on the market are actually purple sapphires. True ruby will be pure red in color…sometimes called “pigeons blood red”…although we have no idea where that name got started. Perhaps someone who owned ruby jewelry was out hunting one day. Perhaps they shot a pigeon at close range and got a first-hand comparison. We do not know….but that is theterm that has been applied to the finest color of ruby for many decades.

Source: Many places world-wide including Mogok, Myanmar (Burma), Thailand, Australia, Tanzania, Viet Nam, and many other deposits.

Chemical: Al2O3…Aluminum Oxide with a sprinkle of chromium for color.

Formation: Ruby is formed by contact metamorphism when granite forming lava intrudes into limestone marble.

Unusual Properties: Ruby can offer asterism, chatoyancy, and a variety of other phenomena.

Colors: Red when correctly categorized. The purplish red stones that are often called ruby would correctly be called purple sapphire. However, the actual line of demarcation of ruby to purple sapphire is a very wide and nebulous separation. If all of the purple sapphires that are called rubies were to be sold as purple sapphire…there would not be a lot of ruby on the market in affordable ranges.

Wearability: Excellent. Ruby is the second hardest gemstone on the Mohs Scale, and one of the best gemstones for all types of jewelry items.

RI: 1.766 – 1.774

Birefringence: .008

Optic Character: Uniaxial Negative U –

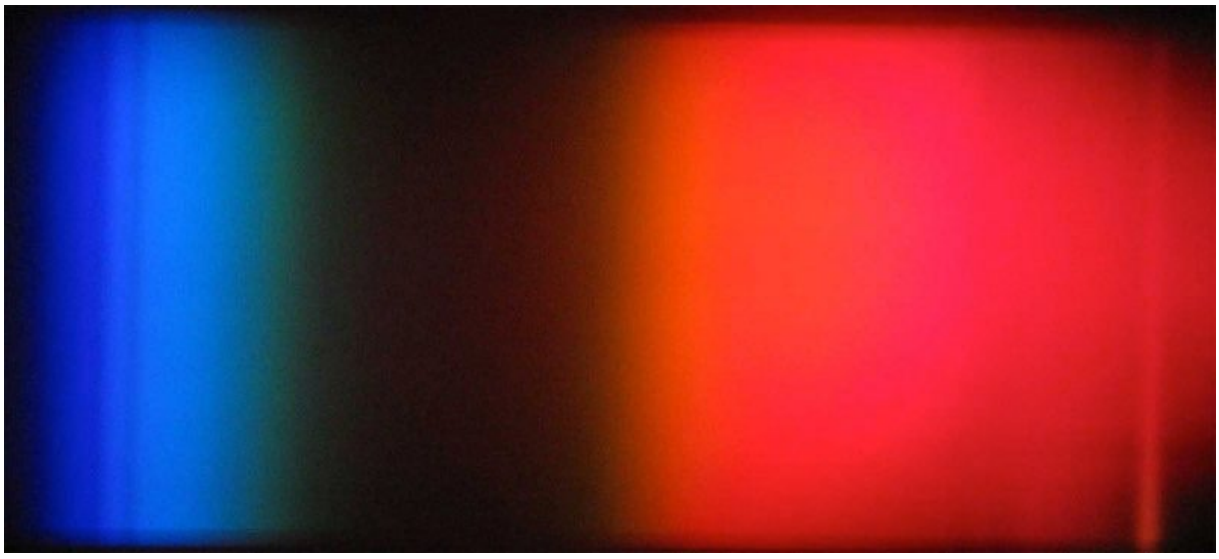
Specific Gravity: 4.00 average

Crystal System: Hexagonal (trigonal in some parts of the world)

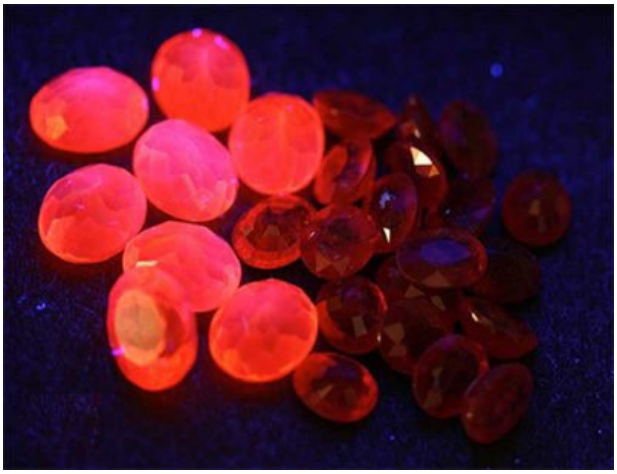
Hardness: 9

Transparency: Transparent to opaque

Special Identifying Properties and Tests: Several. ruby will offer a specific and diagnostic spectrum as seen below. This spectrum should make a fairly easy separation from red spinel which is sometimes mistaken for ruby. Although synthetic rubies will also give this spectrum, the marked increase in chromium lines will help separate synthetic rubies from natural.



Synthetics: Several. Fluorescence due to lack of iron in created ruby is one test that should be considered indicative and not diagnostic. Lab created ruby will shine bright in ultra-violet light due to lack of iron. Curvedstriations in flame fusion, and cell pattern of hydrothermal, are also excellent indicators. The perfection of a pulled synthetic ruby will be agood indicator for created as rubies will often have some form of natural inclusions.



Lab created ruby's reaction brightly to ultraviolet light, while natural rubies on the right stay basically inert.

Imitations: Many and varied. Great care should be given whenever you are offered a completely flawless ruby as there are many synthetic, treated, and imitation rubies out on the market.

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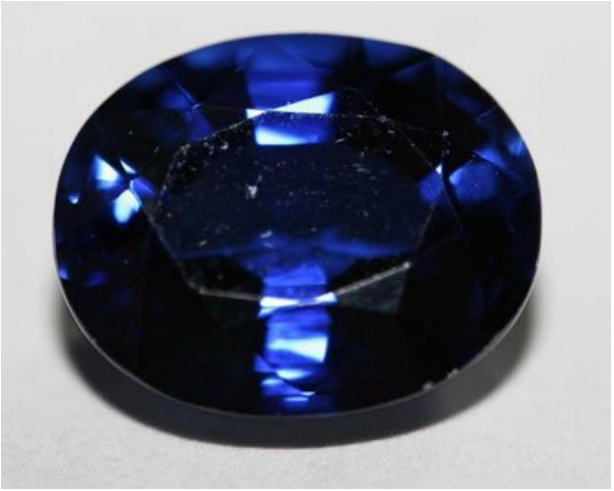
SAPPHIRE



The name sapphire is properly applied to all colors of corundum other than red. This encompasses a complete rainbow of colors.

Source: Many places world-wide including Mogok, Myanmar (Burma), Thailand, Madagascar, Australia, Tanzania, and many other deposits.

Chemical: Al2O3…Aluminum Oxide with a sprinkle of iron and titanium for blue color. Pink is colored by chromium. And iron is the coloring element for most yellows and greens.

Formation: Sapphire is formed by contact metamorphism when granite forming lava intrudes into limestone marble.

Unusual Properties: Sapphire can offer asterism, chatoyancy, and a variety of other phenomena. Stars will be six rayed owing to the hexagonal crystal shape of corundum. Care should be taken not to confuse star sapphire with other star stones.

Colors: Every color but red. Many of the strong purple sapphires on the market are sold as rubies due to the higher per carat price normally afforded to ruby. However, if the stone is of purplish red to reddish purple,it should be properly called a sapphire according to most gemologicalorganizations.

Wearability: Excellent. Sapphire is the second hardest gemstone on the Mohs Scale, and one of the best gemstones for all types of jewelry items.

RI: 1.766 – 1.774

Birefringence: .008

Optic Character: Uniaxial Negative U –

Specific Gravity: 4.00 average

Crystal System: Hexagonal (trigonal).

Hardness: 9

Transparency: Transparent to opaque

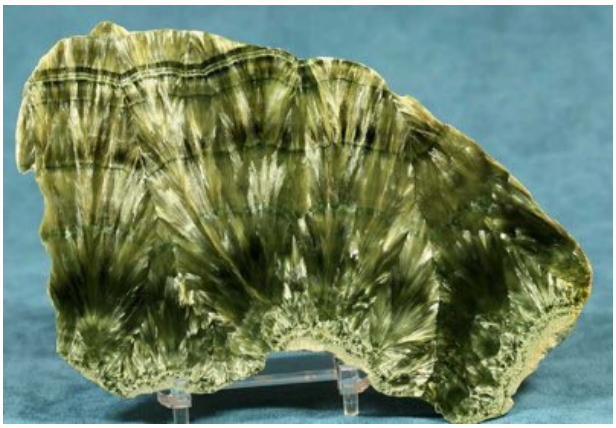
Special Identifying Properties and Tests: The problem of identifying sapphire is usually not the ID of sapphire, but of lab created sapphire and treated sapphire. There is just not much else in the 1.76 RI range that is uniaxial that will be anything other than a sapphire. The 450nmspectroscope line is highly indicative of a natural sapphire that is unheated.

Synthetics: Several. Sapphire has been created by the flame fusion method for over a century, and the hydrothermal method of decades. These are beautiful and viable sapphires but you must disclose the origin as you are liable for proper representation of your merchandise.

Imitations: Many and varied.

66

SERAPHINITE



What color is it?: Light to dark mottled green with a feather-like appearance.

What is the story behind this gemstone?: Seraphinite is named for Seraphim, one of the highest angels from the Old Testament Book of Isaiah. The feathered-wing appearance reminded the first miners of angel's wings, hence the name.

Can I wear it every day?: Yes, it is a very tough gem material.

Is it expensive?: No. It is along the same price as a nice piece of carnelian or labradorite.

Is it a birthstone?: No.

What do I need to know before going shopping?: You may have to look around to find jewelry items that contain seraphinite in local jewelry stores. Although it is a well-established gemstone it has only recentlybecome very popular in the market.

Source: The Russian region of Siberia is the only known source for the finest quality seraphinite.

Chemical: (MgFe2)5 AL(Si3Al)O10 (OH)8....a rather long and convoluted chemical equation.

Formation: In massive formations.

Crystal System: N/A

Unusual Properties: Unique formation that appears like feathers when properly cut.

Other Names: Chlorite Jade (incorrect usage)

67

SCAPOLITE

Although rather rare to find in jewelry items, scapolite is a very important gemstone for gemologists to study. Due to the very close resemblance of purple scapolite to amethyst, it should be a stone that you are well aware of in your gemstone directory.

Source: Many places world-wide including Mogok, Myanmar (Burma), Madagascar, Brazil.

Chemical: A very complicated and long equation of sodium calcium aluminum silicate. Nothing that will be important for identification

purposes.

Formation: Contact zone igneous and pegmatite formations.

Unusual Properties: Chatoyancy.

Colors: Most often seen in yellow (above), pink, violet, and colorless.

Wearability: Fair. Not seen much in jewelry due to hardness factor.

RI: 1.54 – 1.56 (remember that purple scapolite has the same RI as amethyst)

Birefringence: .02

Optic Character: Uniaxial Negative U –

Specific Gravity: 2.65 average

Crystal System: Tetragonal

Hardness: 6 average

Transparency: Transparent to translucent

Special Identifying Properties and Tests: If you compare the RI and SG of purple scapolite to amethyst you will see they are virtually identical. The optic sign is diagnostic for separation as quartz is uniaxial positive and scapolite is uniaxial negative.

Synthetics: None. The chemical equation is far too complicated and there would be no market for it anyway.

Imitations: Many possible including citrine, amethyst, glass, plastic, golden beryl, chrysoberyl.

SERPENTINE

Serpentine is the common name given to a gemstone that comes in a lot of color combinations and varieties. The most common is the yellowish green color as seen above. This is widely used for carvings and jewelry items when cut as cabochons. You may hear names such as **bowenite** and **williamsite**, both are types of serpentine. And even the dangerous name of **asbestos** is a type of serpentine…although not used in jewelry or carvings. In general, the green to yellowish green as seen above is what you will mostlikely encounter. It can easily be confused with jade so be careful when buying or selling and stay with a reputable dealer.

Source: Many places world-wide.

Chemical: A very complicated and long equation of magnesium silicate. Nothing that will be important for identification purposes.

Formation: In metamorphic rocks usually rich in olivine, from which it gets it characteristic green color.

Unusual Properties: None.

Colors: Most often seen in yellowish green in the jewelry and carvings industries. Can also occur in reds, purple and bronze colors.

Wearability: Fair. With a hardness range in the low end of the scale, cabochons are about the only way to cut and set serpentine to use injewelry.

RI: 1.560 – 1.571

Birefringence: None due to opaque nature.

Optic Character: None

Specific Gravity: 2.46 average

Crystal System: Monoclinic but rare to ever find as crystals.

Hardness: Average 4 in jewelry type serpentine. But can vary widely.

Transparency: Opaque to sometimes translucent in finer quality.

Special Identifying Properties and Tests: RI should easily separate from jade. Not much else out there that will be a problem.

Synthetics: None.

Imitations: Plastic or glass possible but unlikely. Can be confused with nephrite and jadeite unless properly tested for RI.

SHELL (MOTHER-OF-PEARL)

Shell is the oldest form of jewelry…and money for that manner. Shell decorations have been found as jewelry in the oldest known burial grounds. Today there are a number of types of shells still being used as ornamental jewelry. Most common is the **mother of pearl** shell material taken from the inner lining of oyster shells as shown above. **Mother of Pearl** is considered a fine addition to many watch faces and inlaid jewelry. Going back to the 1970's…some of you may remember the **PUKA** shell necklacesthat were so popular. Almost anywhere you go, and at any time period, you will find shells and shell jewelry and shell ornaments.

Source: Worldwide. Anywhere there is water there is usually a mollusk of some type creating a shell.

Chemical: Calcium Carbonate. Just like pearls, which are created from thesame material.

Formation: As the protective dwelling places of mollusks and other water living creatures.

Unusual Properties: Orient. Shells can offer the same type of **luster** or **orient** that pearls offer, owing to the fact that they are of the same material.

Colors: Virtually any color in the rainbow.

Wearability: Good. Shells have been carved, polished, and tumbled into many shapes of jewelry items.

RI: 1.52 – 1.56 varies the same of pearls

Birefringence: .014 but again varies

Optic Character: None

Specific Gravity: 2.60 – 2.78 average

Crystal System: None

Hardness: Average 4

Transparency: Opaque.

Special Identifying Properties and Tests: Gritty to the teeth test, separated from plastic by flow lines and concave surfaces of plastic.

Synthetics: None.

Imitations: Plastic or glass possible.

70

SINHALITE

Sinhalite is named for the country in which it is most often found…. Sri Lanka from the Sanskrit name: Sinhala. This will not be one that you see a lot set in jewelry, but you will need to know how to identify it because it has been used to imitate chrysoberyl and has confused more than one unsuspecting gemologist. Known only since 1952, sinhalite is actually a very pretty gemstones in its own right. It is only because of rather scarce availability that this stone is not a major player in the gemstone world.

Source: Mainly from Sri Lanka and Myanmar. But can also be found in Russia and the United States.

Chemical: Mg (AlFe)BO4 Magnesium aluminum iron borate

Formation: Metamorphic contact zones in conjunction with limestone.

Unusual Properties: None

Colors: Brown with yellow and/or green overtone modifying colors.

Wearability: Fair to good.

RI: 1.669 – 1.707

Birefringence: .038

Optic Character: B-

Specific Gravity: 3.48 + –

Crystal System: Orthorhombic

Hardness: 6 1/2

Transparency: Transparent

Special Identifying Properties and Tests: Can be confused with chrysoberyl but RI and optic character should be diagnostic. The color is too brown to be confused with peridot.

Synthetics: None.

Imitations: Plastic or glass possible but not likely.

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SODALITE

Source: Russia, USA, Brazil, and others

Chemical: Cu3(CO3)2(OH)2, a carbonate of copper

Unusual Properties: The blue and white coloring of sodalite make this the most unusual and notable property.

Colors: Medium to dark blue with white veins as seen above.

Wearability: Excellent.

RI: 1.49 average

Birefringence: None

Optic Character: None

Specific Gravity: 2.40 average

Crystal System: Monoclinic

Hardness: 6 average

Transparency: Opaque

Special Identifying Properties and Tests: If viewed through a Chelsea filter, sodalite will show a moderate to strong red color. This, along with color combinations, should be diagnostic for natural sodalite.

Synthetics: None

SPHALERITE

Source: United States and Mexico primary sources, also found in Africa and other countries.

Chemical: (Zn,Fe)S a sulfide of zinc.

Unusual Properties: None

Colors: Intense orange-red

Wearability: Care should be taken as sphalerite is fairly soft when used as a gemstone.

RI: 2.36 - 2.37, over the limit of the refractometer

Birefringence: .010

Optic Character: Uniaxial

Specific Gravity: 4.00 average

Crystal System: Tetragonal

Hardness: 4 average

Transparency: Translucent to Transparent

Special Identifying Properties and Tests: The high refractive index and colors make identification fairly easy for a trained gemologist. The brilliance of the colors is unique to sphalerite.

Synthetics: None.

SPHENE

One of the rarities in the gemstone world is that it does not get a lot of respect. Sphene was once considered basically a collector's item, owing to the fact that it was difficult to find on the market, and stones larger than 1.00 carat were even more difficult to find. That changed in the past few years as the availability of sphene greatly increased with new finds in Brazil. Today, it is an excellent gemstone to use for pendants and earrings. The unusual property of dispersion offered by sphene is so extreme that the stone actually appears to be a rainbow of colors, rather than the yellowish greenof the crystal.

Source: Mainly from Brazil and Mexico

Chemical: CaTiSiO2 (called **titanite** by some reference books)

Formation: Igneous rock formations

Unusual Properties: Extreme dispersion, unlike anything else in the gemstone world.

Colors: Green to yellowish green. But the dispersion or fire of the gemstone makes it appear to offer every color of the rainbow.

Wearability: Fair. Is somewhat brittle. Best for earrings and pendants.

RI: 1.885 – 2.050 (over the refractometer limit)

Birefringence: .105 (very high)

Optic Character: B+

Specific Gravity: 3.52 + –

Crystal System: Monoclinic

Hardness: 5

Transparency: Transparent

Special Identifying Properties and Tests: The dispersion of sphene is something that once you see it…you will always know it when you see it again. The dispersion is quite difficult to photograph due to the directional properties of the light refraction. You can never really see it properly from a camera view because the wonder of the dispersion comes with holding the stone and turning it around under the light. But the dispersion of sphene is the most outstanding feature of this gemstone.

Synthetics: None.

Imitations: None that are believable.

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SPINEL

For many years, the word “spinel” was used by many consumers to mean a synthetic gemstone. Mainly because synthetic spinel has been on the market since the early 1900’s. But in reality, spinel is a beautiful gemstone that occurs in well-formed octagonal crystals (as seen above) just like diamonds. The red color of spinel will rival most rubies. In fact, the Black Prince’s Ruby in the Crown Jewels of England is actually a red spinel.

Source: Myanmar, Afghanistan, Sri Lanka, Brazil, and the United States.

Chemical: Mg(Al204) Magnesium Aluminum Oxide

Formation: Igneous rock formations

Unusual Properties: None.

Colors: Red, blue, and yellow in most cases. Although browns, greensand blacks are possible.

Wearability: Very Good.

RI: 1.712 is the normal RI. Can vary with varieties of colors

Birefringence: None

Optic Character: Isometric

Specific Gravity: 3.60 average

Crystal System: Cubic

Hardness: 8

Transparency: Transparent

Special Identifying Properties and Tests: The main issue of spinel identification is whether the stone is natural or synthetic. Due to the unique placement of spinel on the refractive index chart there is just not much else going to offer you mainly blue or red stones of single refraction in the 1.71 range of the RI scale. As a result, you should have no problem with identification if you are close to a refractometer. If not…the spectrum of red spinel is a fairly easy identification. Although colored by chromium like ruby, the extinction band of the spectrum is far larger than ruby.

Synthetics: Yes. Both flux melt and flame fusion.

Imitations: Many possible

SUGILITE

Named for the Japanese geologist who discovered it in 1944, sugilite is actually a sister stone to Larimar that we studied earlier. It has a characteristic purple color that is unlike almost any other gemstone on the market. It is normally found in massive form…meaning that it rarely forms as crystals. Sugilite is used for jewelry items, and also as decorative ornaments and carvings.

Source: South Africa is the major source of sugilite

Chemical: KNa2Li3(FeMnAl)2Si12O30…and do not worry, this one will never be on an exam!

Formation: Igneous rock formations

Unusual Properties: None.

Colors: Purple with a black mottling throughout the stone is most often seen.

Wearability: Very Good.

RI: 1.607 – 1.610

Birefringence: None

Optic Character: U-

Specific Gravity: 2.74 average

Crystal System: Hexagonal

Hardness: 6 average

Transparency: Opaque

Special Identifying Properties and Tests: None really needed once you see sugilite. There is just not much out there on the markets that will emulate sugilite for the purple color and the black mottling.

Synthetics: None known or anticipated

Imitations: Many possible

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SUNSTONE

Sunstone is one of those gemstones that some people confuse as a synthetic or imitation. Mainly due to the popularity of **goldstone**, which is indeed an imitation. But natural sunstone is a member of the feldspar group,a very large isomorphous replacement series of gemstones that includes

many types of stones. Sunstone owes its name to the bright schiller effect it gives off due to many very small platelets of copper or hematite inside the stone. The sparkling appearance of sunstone, sometimes called schillereffect, is unique to sunstone, and a big help in making the separationbetween natural sunstone and imitations.

Source: Oregon in the US is the most famous at this time based on the copper-based schiller found there. But other sources include India, Canada, and Russia. The Tibet andesine sunstone has proven to be a hoax. There is no mine in Tibet for sunstone that has been proven.

Chemical: Complex sodium calcium aluminum silicate

Formation: Igneous rock formations

Unusual Properties: Sometimes referred to as aventurescence due to the glitter effect. But schiller is the term most correctly used to describe the unusual property of sunstone.

Colors: Orange, brownish-red, and red colors are the most often encountered.

Wearability: Very Good

RI: 1.532 – 1.542

Birefringence: Virtually none. .01

Optic Character: Biaxial Positive B+

Specific Gravity: 2.62 average

Crystal System: Triclinic

Hardness: 6 average

Transparency: Translucent to opaque

Special Identifying Properties and Tests: None really needed once you see sunstone. The schiller effect and RI is about all you need for an identification.

Synthetics: None known or anticipated.

Imitations: It can be confused with goldstone, the glass imitation that is filled with tiny platelets of foil. Magnification is key to separation. Below

are images of natural Oregon Sunstone showing the copper platelets below, and a collection of copper bearing Oregon Sunstone rough in the lower image

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TANZANITE

Tanzanite seen through a London Dichroscope.

Tanzanite is the variety name of zoisite that occurs in a dark brownish color in its original form. This trichroic gemstone was made famous by Tiffany and Co, who first introduced it to the United States market. It is named for the country in which it is found, Tanzania, which is the only place in the world where a commercially viable deposit of tanzanite is to be found. Although a bit on the brittle side for goldsmiths and those setting it, tanzanite offers a unique experience in the world of gemstones; being ableto provide the wearer with two separate colors at the same time. That being blue and purple. Although many gemstones will offer two colors or more, most of their colors are so close together on the visual spectrum that our

eyes cannot discern the separate colors, and instead put them into one. Ruby is on example as it offers one dark red and one lighter pink color. But our eyes cannot detect the two separately because they are so close together on the scale. Tanzanite, however, offers colors that are very far apart on the visible spectrum. In fact, opposite ends. Violet…and purple. As a result, our eyes are able to differentiate the two, and identify that this gemstone is providing two distinct and visible colors to the wearer. Tanzanite is a brownish color when it comes out of the ground. It is heated to take most of the brown out and leave the blue / purple.

Source: Tanzania

Chemical: A highly complicated equation of calcium aluminum silicate. Which is why it will probably not be synthesized for a long time to come.

Formation: Igneous rock formations.

Unusual Properties: Trichroism. The two colors of blue / purple are easily visible in larger stones of deep colors. The third color of brownish gold can be seen using a Chelsea filter.

Colors: The best colors will be intense blue ;/ purple and gold flashes.

Wearability: Fair to good. Tanzanite can be rather brittle when worn in rings if not cut to proper depth proportions.

RI: 1.691 – 1.700

Birefringence: .009

Optic Character: Biaxial Positive B+

Specific Gravity: 3.35

Crystal System: Orthorhombic

Hardness: 6 1/2 average

Transparency: Transparent

Special Identifying Properties and Tests: Dichroscope and Chelsea filter are all you need to identify tanzanite. There is not another natural gemstone out there going to give you the extreme dichroic color separation

of tanzanite. And when coupled with the third color of golden brown visible through the Chelsea filter…that should be all you need to take with you to identify tanzanite.

Synthetics: None known or anticipated. Too complicated. But many imitations. There are no synthetic tanzanites on the market at this time.

Imitations: Synthetic forsterite will give you very close RI readings and a very similar dichroscope reaction but will be inert to the Chelsea filter. There is a polysilicate with a blue outer and purple inner glass core that will look very much like tanzanite. It is even doped to give a red reaction to the Chelsea filter. However, the Chelsea filter reaction is just toobright red to be confused with natural tanzanite, and the RI of the polysilicate is close to 1.54 on average, so it should pose no threat either.

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TOPAZ

Topaz occurs in many colors, tints, and hues. They are found in many parts of the world and form in crystals that can weigh several kilos. Topaz prices run from very cheap, to very expensive, rivaling some of the most expensive colored gemstones on the market. The main issues with topaz areto know that there are no synthetics, that there are a lot of trade names out

there that are as varied as the colors of topaz themselves, and that topaz prices will vary widely with the various varieties.

There is something of a conflict with the naming of topaz between the GIA and the rest of the world, regarding the use of the term **"Imperial Topaz."** The GIA holds that only the unheated variety of peach that has color concentration at the ends of the cut stones should be terms Imperial Topaz. However, in most of the other world markets, the term Imperial Topaz is used to refer to any of the rarer colors of topaz, those being pink, red, champagne, peach, and salmon. Mainly due to the rarity. However, most of these colors are derived by heating the cherry red topaz. So, in spite of the rarity of these colors, the fact that they are the result of heatingis considered a reason to exclude them from being called Imperial Topaz bythe GIA. Who is right? That conflict has been going on for decades. Butyou should be aware of the term Imperial Topaz, and that there are differingconcepts as to the proper application of the name.

Blue topaz is actually colorless topaz that has been irradiated and heated. It is rare to find a natural blue topaz, and certainly in some of the darker colors. So, the colorless stones are irradiated which turns them dark brown to black. The stone is then heated to turn brown to blue. Thecolor is stable. One fun note that you should try….the temperature at which the brown colored topaz turns to blue is attainable in a conventional household oven. If you want to do your own gemstone heating, buy some unheated topaz from a blue topaz dealer (they usually do their own heating anyway). Then you can heat your oven to about 400 degrees F and put the topaz in for about 2 minutes. The brown will turn to blue. One word of caution, however. The irradiation process of topaz leaves residual radiation.It takes about a year after the topaz is treated for the radiation to disappear.However, with the current state of world affairs, there are so many radiationdetectors around the world looking for radioactive materials that it would bedifficult to find a blue topaz that was still radioactive in today's market.

Source: Brazil is the major source. But other sources include Australia, United States, Zimbabwe, Nigeria, and others.

Chemical: Al2(SiO4)(F,OH)2

Formation: Pegmatite Dikes

Unusual Properties: None

Colors: Wide variety possible including colorless, yellow, blue, pink, salmon, cherry red, champagne, and peach…sometimes referred to as Imperial Topaz. The blue topaz names can also vary. Normally the terms: Sky Blue, Swiss Blue, and London Blue are attached to the colors of light blue, medium blue and dark blue, respectively. However, what is London Blue to one dealer may be Swiss Blue to another. So, you have to be careful about buying blue topaz based on a trade name.

Wearability: Very Good. Although the direction of easy cleavage makes cutting topaz quite difficult.

R**I:** 1.610 – 1.638 range will vary based on the color of topaz

Birefringence: .009 average

Optic Character: Biaxial Positive B+

Specific Gravity: 3.53 average

Crystal System: Orthorhombic

Hardness: 8 average

Transparency: Transparent

Special Identifying Properties and Tests: None. Be careful about pink topaz. The iron content will cause the RI to be up in the pink tourmaline RI range. This has caused many good gemologists with limited experience in pink topaz to make a wrong identification…and cost consumers and jewelers a lot of headaches.

Synthetics: None known or anticipated. The chemical equation of topaz is too complicated to synthesize at this time.

Imitations: Many possible.

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TOURMALINE

Paraiba Tourmaline from Paraiba, Brazil

Tourmalines occur in every color of the rainbow. It is one of the few gemstone groups that occur in every color because it is one of the most famous of the isomorphous replacement series groups of gemstones. Above is a classic and authentic Paraiba Tourmaline from the mines in Paraiba, Brazil.

Tourmalines were originally found in Sri Lanka in the early 1700's, but Brazil has now become the largest producer of tourmalines due to the expansive network of pegmatite dikes that traverse that country. Owing to the fact that this is a major isomorphous replacement series of gemstones,

tourmaline properties will vary. Gemologists have to be aware of the many possible ranges of readings you may get when identifying tourmalines.

Source: Brazil, United States, Sri Lanka, and others.

Chemical: An extremely long and interchanging combination of elements based around an aluminum silicate.

Unusual Properties: Many possible. Most notable is bi-color crystals. Be aware that some tourmalines can have up to seven colors within the same crystal. Many other possibilities including chatoyancy and color change.

Tourmaline comes in every color of the rainbow.

Colors: Any color you can pick out of a rainbow…you will find a tourmaline to match somewhere in the world. Tourmalines can occur with two, three, four and more colors within the same crystal.

Wearability: Very Good.

RI: 1.616 – 1.652

Birefringence: .014 – .044 range possible

Optic Character: Uniaxial Negative U-

Specific Gravity: 3.06 average. Can vary.

Crystal System: Trigonal

Hardness: 7

Transparency: Transparent to opaque

Special Identifying Properties and Tests: Not much else in the RI range that should give you a problem. Some new gemologists who rely too much on just the refractometer have mistaken pink topaz for pink tourmaline due to the overlapping readings. But tourmaline's uniaxial negative optic character and SG should leave little doubt as to its identification for the gemologist following proper identification protocols. Of particular note is the spectrum of pink tourmaline, sometimes called rubellite, that varies significantly from ruby and makes an easy separation. Some pink tourmalines can be so dark red as to look like a very fine quality ruby.

Synthetics: None currently known, but tourmaline has been created in the lab so be aware of this and keep a watch out as they will eventually be on the market.

Imitations: Many possible.

TURQUOISE

Turquoise

Turquoise is named for the trade routes that the original source material had to travel through….Turkey. Hence the name: Turquoise. This is actually an oxide of copper that is a sister stone to malachite, chrysocolla, and azurite. Turquoise has a long history from its sources in ancient Persia, fromwhich we get the name for the finest quality turquoise: Persian Turquoise. The first known source of turquoise was in the Sinai region, but those deposits were worked out by ancient jewelry artisans thousands of years ago.

Turquoise is porous and is subject to color degeneration due to oils, hand lotions, etc. Permeating into the stone during wear. Also, heating at 480+F can cause the light blue colors to turn light green, taking an

expensive color of turquoise to an inexpensive color of turquoise using little more than a jeweler's torch. Care should be taken when setting.

Some turquoise is stabilized by paraffin or wax to help seal the stone. This is not a serious treatment to consider as a negative since it helps prolong the life of the gemstone. It is also dyed to improve color. We will talk about how to identify that process later on these pages.

Many people believe that turquoise is only a massive, non-crystalline material. In reality, there was one deposit of crystalline turquoise found in 1911 in Virginia, USA. The specimens are very small crystals but are quite well formed. The ISG Student Reference Library Collection has one of the specimens from that find. .It can be seen below.

Source: United States, Australia, China, Israel, and Afghanistan are the most prominent.

Chemical: A complex degeneration of copper containing aluminum and phosphates.

Formation: In veins of copper ore due to oxidation.

Unusual Properties: None

Colors: A variety of blue to green with many variations and mottling to be found.

Wearability: Very Good.

RI: 1.61 – 1.65

Birefringence: .04

Optic Character: Biaxial Positive B+

Specific Gravity: 2.62 average

Crystal System: Triclinic

Hardness: 6 average

Transparency: Opaque

Special Identifying Properties and Tests: None. Care should be taken to avoid confusion with chrysocolla.

Synthetics: You may run into a variety of possibilities on the current market.

Imitations: Many possible including glass, plastic, and reconstituted turquoise where many broken pieces are compressed to create a turquoise mass which is then cut and fashioned. Dyed turquoise can be identified by the concentration of color in the cracks and surface breaking fissures of the very porous stone.

VARISCITE

Variscite is often confused with turquoise due to the similar color and structure as seen above.

Source: Most notably in the United States, Germany, Australia, andSpain but other locations are known.

Chemical: Hydrous Aluminum Phosphate

Unusual Properties: None.

Colors: Shades of green to blue-green.

Wearability: Excellent.

RI: 1.56 - 1.59 average

Birefringence: .030

Optic Character: Biaxial

Specific Gravity: 2.54 average

Crystal System: Orthorhombic

Hardness: 5 average

Transparency: Opaque

Special Identifying Properties and Tests: None required if the colors are considered.

Synthetics: None

WELO OPAL

Source: Ethiopia

Chemical: Hydrous Silicon Dioxide

Unusual Properties: Play of Color.

Colors: Many possible but blue, green, and red are prevalent in this type of opal.

Wearability: Care should be especially taken with Welo Opal as these are mostly hydrophane, meaning they soak up water quickly and can soak up impurities as well. When these impurities are soaked up by the opal, when the water evaporates the impurities are left in the gemstone causing discoloration and loss of play-of-color.

RI: 1.381 - 1.528 can vary widely

Birefringence: None

Optic Character: None

Specific Gravity: 2.2 average

Crystal System: None (amorphous)

Hardness: 6 average

Transparency: Translucent

Special Identifying Properties and Tests: Same are other types of opal. Often fern inclusions from tiny ancient fern leaves that were present during formation.

Treatments: Well opals have been known to be treated with liquid smoke to create fake black colors. To date, most black Welo Opals from Ethiopia have tested positive for this treatment.

Synthetics: Synthetic opal is widespread on the market.

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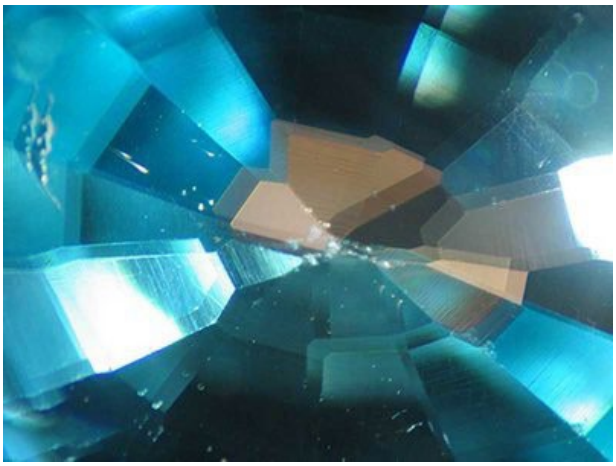
ZIRCON

Zircon is a natural gemstone whose name is sometimes confused with a synthetic. In the late 1950's to 1960's, colorless zircon was used as a diamond imitation, causing the name zircon to become synonymous with synthetic. But in reality, zircon is a rather fascinating gemstone with some unusual gemological properties.

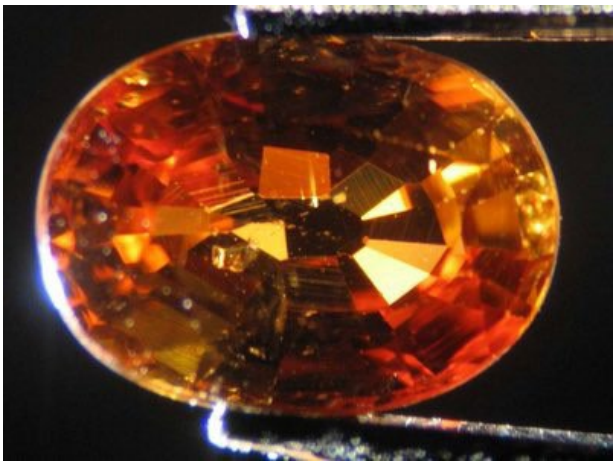
Zircons will occur in several levels, called high zircons, middle zircons, and low zircons. This is due to the level of crystal degeneration due to included radioactive elements in many zircon crystals of yellow to green colors. The elements **thorium** and **uranium** combine to break down the crystal structure of zircon. This causes not only the gemological properties of zircon to vary greatly (hence the terms high to low zircon), but causes an

actual destruction of the crystal itself. Zircons that have lost much of their crystal structure due to the effects of the radiation are known as **metamict**. The main effect of this is that the identification properties of zircon can vary by extreme measures. And while the RI is perhaps the most extreme, it is not a critical variable. Thanks to the extreme doubling of facet junctions due to the high birefringence of zircon, it is still a rather easy identification. There is virtually nothing in the brown, green and blue colors that are over the limits of the refractometer that is going to give the extreme facet junction doubling of zircon as seen below.



Facet junction doubling seen through a 10x loupe with zircon.

Source: Myanmar, Vietnam, Australia, and other locations.
Chemical: Zr(SiO4) Zirconium Silicate
Formation: Igneous rocks
Unusual Properties: None



Colors: Primarily reddish brown, blue (heat treated) and green (due to radiation and quite rare).

Wearability: Very Good.

RI: 1.777 – 1.987…and anywhere in between is possible.

Birefringence: .059

Optic Character: Uniaxial Positive U+

Specific Gravity: 3.90 – 4.71 range

Crystal System: Tetragonal

Hardness: 7 average

Transparency: Transparent. Metamict stones can appear almost opaque due to crystallization breakdown.

Special Identifying Properties and Tests: Beyond the facet doubling and very high RI, the spectroscope can be diagnostic. Zircon has many absorption lines, perhaps more than any other gemstone you will test. Mainly due to the rare metals involved in its formation. But the lines can beso slight as to be difficult to photograph in real life. Look at the image below. Notice that there is a large absorption band in the red. But if you move your head back from the screen a bit…you will see at least 4 to 5lines in the green, and an additional line of two in the red next to the green. Difficult to capture on camera, but fairly easy to see in person. In reality, zircon has a spectrum full of these slight absorption lines that make it an

easy identification through the spectroscope. And I would recommend the diffraction grating spectroscope for zircon. Many of the lines are located in the green to red areas, and the diffraction grating spectroscope will give you the best view of these absorption lines.

Synthetics: Well, yes and no. Zirconium is a metal that joins with a silicate to form zircon. It is also the metal used along with an oxide to form cubic zirconia. While there is no true synthetic of zircon…it is the basic building block for cubic zirconia.

Imitations: Many possible.

SUMMATION

Despite the length of this eBook, there is still a long list of possible gemstones out there that could not be included. Some are new and just now reaching the market; some are old and in very limited supply. The most important issue for you as a gemology student is to realize that the earth hasprovided us with a virtually endless list of wonderful gem materials that we should discover and protect whenever possible.

As you enjoy the world of gemstones, remember that there are nouniform standards governing the industry. No oversight rules and no entity with the responsibility to oversee the gemstone markets. With the total lack of any geopolitical barriers to the gemstone market, there are a lot of what we call “pirates” out on the market looking to dupe unwary buyers at all

levels. These can come from all directions including television shopping channels, online sellers like eBay, Etsy, and other websites, and from established gemstone dealers who may or may not be aware of what they are selling. The main issue is that if you buy and sell gemstones, it is your responsibility to know your products, to know your gemstones. If you sell a gemstone to a customer and it turns out the gemstone was misrepresented for any reason, you are legally responsible for the loss to the client. The concept that your dealer is responsible to properly disclose information to you is a nice idea but is no legal protection for you in case of problems. You are personally responsible for all gemstones you sell, so you need to know your gemstones.

It is the purpose of the International School of Gemology to provide our students and community members with the most up-to-date information possible. For this reason, this book will be updated from time to time. It will be available to our graduates as long as you maintain your active status as an ISG Graduate. Please feel free to contact us to make suggestions. Thank you for being a part of the International School of Gemology.

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