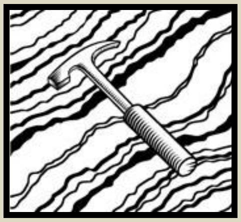
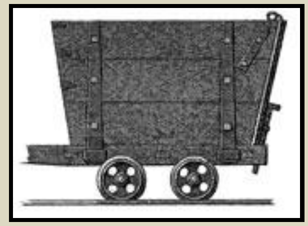
Gem Hunter – The Prospector's Newsletter





Vol 3, No 3, May-June. 2011 *Newsletter from the GemHunter*

GOLD NUGGET FROM CALIFORNIA

Modified from an article that appeared in the Sacramento Bee by Carlos Alcala (March 16, 2011). A huge gold nugget found last year in Nevada County, California was sold in Sacramento to an anonymous bidder for $400,000. The nugget, named the Washington Nugget, weighed nearly 100 troy ounces - about 7 pounds. Several sizable nuggets have been found in the US besides the Washington Nugget, particularly in the gold country in California, Alaska and Montana.

Photo from ***Sacramento Bee***.

LARGE DIAMOND FOUND IN THE US

Millions of carats of diamonds of all sizes continue to be mined in Canada making our northern neighbor one of the major diamond producers in the world. It is likely similar diamond deposits could be found and developed in the US, but the Federal government and its bureaucrats have stymied much of the exploration and development in our country. Even so, some attractive diamonds are periodically found in Arkansas.

For those of us who have spent time at the Crater of Diamonds State Park in Arkansas, this is a park operated by state government and individuals pay a daily fee to enter the park with hand tools to dig for diamonds. At one time, this diamond pipe was thought to be kimberlite, but in the 1980s, it was reappraised and discovered to be diamondiferous olivine lamproite similar to the great diamond deposit at Argyle, Western Australia and similar to the commercial diamond deposits at Ellendale, Western Australia. Lamproites of possible interest have also been found in Kansas, Montana and Wyoming as well as in India. The pipe at the Crater of Diamonds State Park is one of a group of olivine lamproites in the immediate area in Arkansas (Hausel, 1998).

Each year, many diamonds are found in the State Park and recently, another relatively large diamond was found by a tourist from Salida, Colorado who recovered an 8.66-carat diamond dug from the lamproite. About 90,000 diamonds have been found in the state park since the early 1900s. Only

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the State Line diamond district along the Colorado-Wyoming border has produced more diamonds in the US. But Canada is in a league of its own with a group of major and world-class diamond mines and deposits found since the early 1990s.

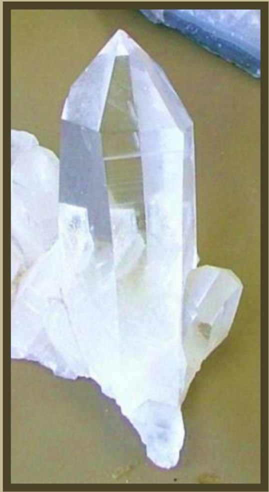
QUARTZ & CHALCEDONY (PART 1)

In this newsletter, we will explore the many characteristics of quartz and chalcedony (includes agate, jasper, flint and other silica minerals). Quartz and chalcedony are both silica (SiO_2) and are only different from one another because of crystallinity and color.

Quartz is the most common constituent of the earth's crust and when found in veins, it can be coarse crystalline with distinct crystals, or can be microcrystalline (massive) with no distinct crystals. So when we speak of *massive*, we are referring to quartz in which we cannot distinguish crystal form by the naked eye.

Auriferous (faulted) quartz vein in metatonalite in the Mary Ellen gold mine, South Pass, Wyoming (photo by the author). This quartz is massive.

If found in crystalline form, the quartz may occur as a hexagonal (6-sided) prism capped by a single hexagonal pyramid.



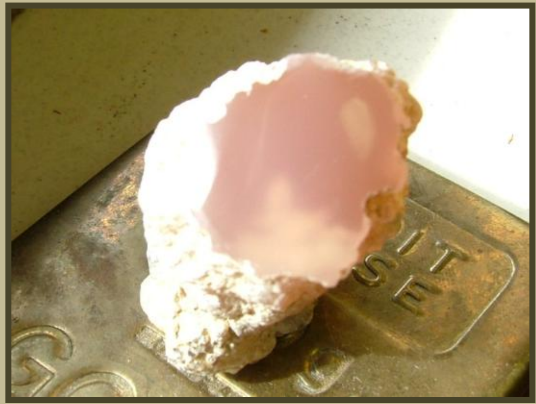
Less common are quartz crystals with doubly terminated pyramids. A very popular locality for doubly-terminated quartz is Little Falls, Herkimer County, New York. Here, collectors recover doubly-terminated quartz that has a misnomer of Herkimer diamonds which is found in dolomite.

Right – hexagonal quartz crystal prism from Hot Springs, Arkansas capped by a hexagonal pyramid (photo by the author).

Years ago, I met a person who had a healing room in their house. This room was filled with well-crystallized quartz for healing. Scientifically, there is no evidence that quartz can heal a person other than by psycho-somatic healing. Healing with crystals is like putting your trust in Congress not spending your money. This may not be a good analogy as there is plenty of proof that politicians rob tax-payers – it called an election. Quartz is found as (1) rock crystal; (2) amethyst; (3) citrine; (4) smoky; (5) rose; (6) chatoyant, or (7) crystalline quartz.

Hardness - Hardness can be measured using what is referred to as Moh's scale. This is a relative hardness scale used by geologists, rock hounds and mineralogists. On Moh's scale, diamond has been assigned a hardness of 10 and graphite only 1. Quartz is assigned a hardness of 7 and is softer than many minerals including diamond, corundum (H=9) and topaz (H=8). But quartz is harder than your car's windshield, which typically has a hardness between 5.5 to 6. This is why your windshield gets pitted when you travel in areas with blowing sand like Arizona. The quartz sand will scratch and pit the softer windshield.

Color - Quartz is found in a multitude of colors that include colorless, white, red, orange, yellow, gray, brown, black, lavender, violet, purple, pink, blue and green. Essentially every color of the rainbow has been seen in quartz and chalcedony. In its chemically pure form, quartz is colorless to white. As with other gemstones, small amounts of chemical impurities will give quartz some color.



The color in rose quartz is due to trace amounts of titanium within the crystal lattice – photo by the author.

The various valence states of iron produce many colors in quartz, the most important is purple to red-violet that is seen in amethyst, and lemon-yellow of citrine. Iron is also responsible for reds, yellows and browns in many agates and gives carnelian and jasper their brownish-reds and orange colors. Iron and/or manganese will produce browns and blacks in dendritic agates, traces of titanium cause the characteristic pink in rose quartz, and nickel gives chrysoprase its apple-green color.

Right. Trace amounts of iron are responsible for coloring amethyst.

Mineral inclusions in coarsely crystalline quartz and in cryptocrystalline varieties may impart colors as well as optical effects such as chatoyancy. Mineral inclusions are simply tiny crystals that grew within a quartz crystal.

Specific Gravity. Quartz has a specific gravity of about 2.65, indicating that it is more than twice as heavy as water (it doesn’t float in liquid water). Even so, quartz is light enough that it is easily washed out of gold pans in a search for gold. Gold has a specific gravity of 15 to 19.3 (5.5 to more than 7 times as heavy as quartz), which is why gold stays in a gold pan unless you get way to energetic.

Cleavage – Quartz does not have cleavage (most of the time). In other words, you are not going to break quartz along distinct planes like diamond. If you strike quartz with a chisel and hammer to try to cleave it like you would a large diamond, the quartz will just break along conchoidal fractures (like broken glass).

Photo of ~12 carat ruby from the central Laramie Range, Wyoming, one of several ruby deposits discovered by the author using geological detective work. This particular ruby

has excellent color as well as cleavage. Note the parallel lines within this gemstone: these are planes of weakness. If you struck this ruby with a chisel parallel to the cleavage, it would likely break along one of the planes to produce a distinct, flat surface.

The conchoidal fracture of quartz reminds me of a Cheyenne family who visited my office at the University of Wyoming. This family was under the impression they had found the largest diamond on earth: it was the size of a football. They apparently had been misled by a gemologist in Cheyenne that it was most likely a diamond, and they needed to have it verified by someone with experience in raw diamonds (that was a very good suggestion). When they brought it to my office, I knew immediately it was rock crystal, but I wanted to let them down slowly.

I toyed with them a little bit and then finally got out a diamond chip and cut their quartz with little effort. They were visibly disturbed that I would dare scratch the diamond that would pay for their mansions and allow their off-springs to live a life of luxury for the next few centuries. After I pointed out that if it had been diamond, I would have had a very difficult time cutting the stone with another diamond and they forgave me for a short time and left.

BUT – they were not done. On our staff, we had a person who contributed a lot to the geology of Wyoming and was a productive member of the Laramie community, but he was somewhat of a klutz. Ray died of an unfortunate and untimely death in 2006, that still needs to be investigated by the State of Wyoming.

Sketch of geologist examining rock with a hand lens.

But back to our story. Ray was a very good field geologist, but he was not good at mineralogy. A few weeks later, when this same family came back to the university, they asked to see Ray and avoided me. Ray told me what was going on and I said he should go ahead and give them a third opinion. What these people didn't know was that Ray had no experience with diamonds. During this gathering, Ray indicated he wanted to look closer at the stone. He stood up and carried the stone to his lab, but dropped the stone before he reached the lab table. It was classical Ray and I wish I could have seen everyone's expressions – it would have been priceless. Here was a diamond much larger than the 3,106-carat Cullinun (the largest diamond ever found), that was dropped on the floor shattering into dozens of pieces.

Ray's response: *"Well, it has conchoidal fracture, so it's probably not a diamond"*. Ray was partially right.

Diamonds also have conchoidal fracture along with cleavage. So if it would have had been a diamond and dropped, it would have produced pieces with conchoidal fracture as well as pieces with flat, smooth, cleavage planes. But it didn't matter. This was just another piece of rock crystal (massive quartz) – one of many dozen I had examined for prospectors with diamond fever over the years.

Crystal Habit. Quartz crystallizes in the trigonal (hexagonal) system (Hausel, 2009). Coarsely crystalline quartz most often is found as anhedral grains and masses. Large crystals usually form singly terminated hexagonal prisms striated perpendicular to the c-axis (*the c-axis is an optic axis that is parallel to the hexagonal prism*) and capped by a pyramid or rhombohedra. Such prisms typically range from microscopic to crystals weighing several hundred pounds. Periodically, doubly terminated prisms are found that are bipyramidal, but are less common.

Amethyst typically is dominated by forms with rhombohedral faces, a habit that is typical of crystals which grow simultaneously on walls of open cavities.

Odd specimen of jade. Most people would mistaken this as quartz since it is hexagonal and found near prismatic quartz in granite gneiss. But instead it is a jade pseudomorph after quartz. Over millions of years, jade slowly replaced the original quartz crystal one atom at a time while adopting the hexagonal shape of quartz. This and several other pseudomorphs were discovered near the Tin Cup district in central Wyoming by the author.

Twinning. Quartz crystals are often twinned and exhibit two different crystals that grow together.

Size. Quartz crystals vary from microscopic grains to specimens weighing several hundred pounds. On the extreme end, rock crystals have been found that weigh many tons. Pyramidal amethyst crystals up to 10 inches in diameter have been recovered from Thunder Bay, Ontario.

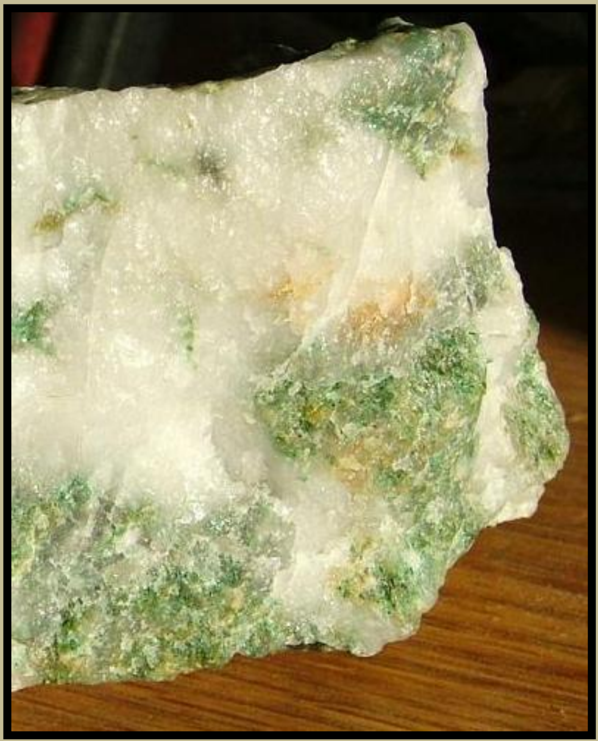
Mineral Associations & Inclusions

Quartz, being a common constituent of many rock types, is found in association with a variety of minerals. These include feldspar, muscovite, biotite, chlorite, tourmaline, beryl, hematite, iolite, barite, fluorite, nephrite jade, gold, sulfides and others too numerous to mention (Hausel and Sutherland 2000, 2005). Many of these associated minerals occur as inclusions within quartz crystals.

The later introduction of silica-rich fluids in the presence of other minerals is responsible for many mineral inclusions (foreign inclusions) found within quartz. Many of the better-known inclusions give rise to type names often listed as subspecies of semi-precious gem quartz.

Fuchsitic quartz from the Granite Mountains Wyoming. Places where fuchsitic quartz and quartzite have been found include Copper Mountain, South Pass, Seminoe Mountains, Elmers Rock, Medicine Bow Mountains, Sierra Madre and the Rattlesnake Hills, Wyoming.

Reddish-brown hematite flakes and flakes of green fuchsite mica produce a glittery metallic appearance (aventurescence) in some quartz and quartzites. Rutilated quartz (quartz containing mineral inclusions of rutile needles) commonly exhibits yellowish-brown to golden-yellow colors, but also produces copper-red and silver-gray colors. Although rutile in quartz is relatively common, rutile in highly transparent quartz is rare.



Gold has always been noted in association with quartz to such a degree that prospectors almost always dug on quartz veins in a search for the precious metal. Visible gold in quartz, most commonly in milky quartz, is cut and polished in a variety of shapes and sizes and used as jewelry or for specimens. Striking specimens of gold-in-quartz have been recovered from the Badger mine, Mariposa County, California, the Sixteen-to-One mine in Sierra County, California, the Potato Patch in Arizona, and from Canada and Australia.

Milky quartz with native gold and mariposite mica from Canada (photo by the author).

Less commonly found in quartz are inclusions of covellite (copper sulfide), which may produce an electric pink schiller in smoky and colorless quartz.

Gas-fluid inclusions are common in quartz and most are microscopic, but large visible fluid inclusions occur. Analysis of gas-fluid inclusions provides a wealth of information about pressure, temperature, and chemical environment under which quartz crystallized. Such inclusions are often present in amethyst with the greatest abundance near the base of the crystals. These inclusions are primarily formed of gaseous and liquid carbonic acids (*Kievlenko 2003*). Carbon dioxide, water, and common salt are also found as inclusions (*Bauer 1968*), as are natural petroleum fluids, gases, and solids (*Koivula and Tannous 2004b*). Doubly-terminate quartz crystals from Herkimer County, New York have been known to host amorphous asphaltite hydrocarbons in inclusions. These originate within silicified dolomites, and appear to have developed during digenesis of the host rock.

Varieties

Rock Crystal. Rock crystal is colorless quartz. Because of its low refractive index (the amount of light that is bent to produce a rainbow) and glassy appearance, it is seldom used as a gemstone. It exhibits characteristics similar to synthetic glass – thus it has few properties that would make it attractive for adornment. Some colorless raw quartz crystals have periodically been used in earrings and necklaces due to the characteristic hexagonal prisms that are visually interesting.

Amethyst. Amethyst is colored quartz that ranges from mauve to deep violet. The coloring agent for amethyst is small amounts of Fe^{3+} that is distributed in the crystal structure in layers typically parallel to the rhombohedral faces. Thus in many cut stones clear bands of quartz may be seen alternating with colored bands. Amethyst has been one of the more popular gemstones throughout history and is even mentioned in the Bible as one of 12 sacred stones. It is generally considered the most valuable of all the quartz gemstones.

Gems with similar color were once grouped together centuries ago, such as amethyst and sapphire. This is the origin for the term *oriental amethyst* that has been applied to sapphire with a similar color to amethyst. The color in amethyst can be modified through heat treatment at temperatures of 250 to 350^{o}C. At these temperatures, the stone will become colorless. The color can be restored by radioactive irradiation. At higher temperatures (450 to 500^{o}C) the color is irreversibly damaged and the mineral may take on a reddish-brown to yellow-citrine color. Amethyst is thought to have a hydrothermal genesis.

Citrine. Citrine is a pale- to dark-yellow, brownish-yellow, or honey-yellow quartz with a russet tint named after its resemblance to citrus lemons. It has been mistaken for topaz particularly in the ancient past and has erroneously been given additional names such as *'topaz quartz'*. Even so, citrine can be distinguished in both faceted and natural form from topaz by index of refraction and specific gravity. In hand specimen, the crystal habit and cleavage is used to distinguish. The specific gravity for citrine (and feldspar gems) is the lowest for yellow, transparent gemstones, whereas topaz is noticeably higher. The luster is slightly inferior to topaz and topaz may show signs of incipient cleavage that would be non-existent in the citrine.

The coloring agent for citrine is iron. Citrines produced by heat treatment of amethyst at high temperatures will have a reddish tint that tends to contrast with the predominant pale-yellow in most natural citrines. According to Hurlbut and Switzer (*1979*), heat treated citrine will exhibit color banding typical in amethyst and lack slight pleochroism seen in natural citrine. Natural citrine exhibits patches and color bands similar to amethyst, although the zoning in citrine is less obvious. Citrine should exhibit a nice vitreous luster generally free of mineral inclusions.

Smoky Quartz. Smoky quartz varies from black to brown to smoky yellow and grades into citrine. The dark color of smoky quartz is thought to be the result of radioactive damage during exposure to radiation. Upon heating, smoky quartz will turn colorless, and will return back to its smoky appearance with exposure to radiation. Rutile needles are common inclusions in smoky quartz. The best-known locality for smoky quartz is the Swiss Alps, where veins have yielded many tons of beautiful crystals. Other notable localities are Russia, Brazil, Madagascar, and Scotland. In the US, smoky quartz has been reported in the Pikes Peak region of Colorado, and at various localities in Maine and New Hampshire.

Smoky quartz from pegmatite south of Laramie.

Rose Quartz. Rose quartz often occurs as coarse-crystalline anhedral (formless) quartz that varies from pale pink to deep rose-red, which often fades upon exposure to sunlight. Rose quartz is seldom transparent and instead is turbid. Its color is thought to be due to the trace titanium. In some rose quartz, microscopic needles of rutile are found oriented in three directions at 120^{o} from one another and at right angles to the c-axis. When manufactured into a cabochon with proper orientation, such rose quartz will produce distinct 6-rayed stars due to light being reflected from the rutile needles.

Chatoyant Quartz. There are several minor ornamental stones of chatoyant quartz. This quartz contains parallel fibrous mineral inclusions that exhibit wavy reflections as they are rotated in light. Rather than fibrous mineral inclusions, Koivula and Tannous (*2004c*) associate chatoyancy with *"thin hollow tubes resulting from growth blockage (growth tubes) and/or post-growth dissolution features (etch tubes)"*. Chatoyancy is also seen in Tiger's Eye, a variety of cryptocrystalline quartz.

In the next issue of the GemHunter, we will visit the many varieties of chalcedony. Some of these are the most extraordinary specimens in the world. Much of the information in this article was summarized from Hausel and Sutherland (2006).

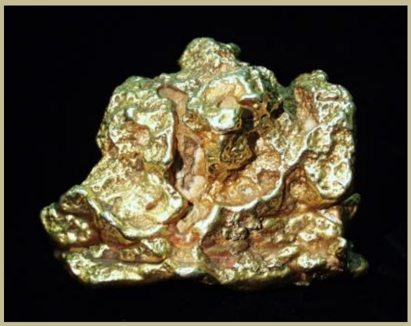
Right - Banded agate geode, one of many varieties of chalcedony.

- Hausel, W.D., and Sutherland, W.M., 2006, ***World Gemstones: Geology, Mineralogy, Gemology & Exploration***: WSGS Mineral Report MR06-1, 363 p.

Wyoming this book can't be beat. Dan Hausel is an expert in this area.

By
Jill Randolph
I was surprised that diamonds aren't always found in coal! This was very informative on different minerals

GOLD – A PROSPECTORS' GUIDE TO FINDING GOLD DEPOSITS
(working title)



Watch for the first volume. The 4th draft is currently being reviewed and will then be sent to the publisher. This book will tell you what to look for and tell you exactly where to look with many Wyoming examples. Book 2 in this series will examine the remainder of the western states.

Over three decades, I found two (possibly 3) major gold deposits and hundreds of gold, silver, platinum and palladium anomalies. I enjoyed finding them – now it's up to you to explore and mine them.

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