



# Minerals of the Month

Since January 2016, every issue of *The Mineral Newsletter* has featured a Mineral of the Month describing a particular mineral, along with at least one striking photo. The articles show what each mineral looks like and give information about it, drawing on sources ranging from Mindat to the U.S. Geological Survey. Club member Sue Marcus has written almost every Mineral of the Month, and club member Bob Cooke has supplied many of the photos. Both thank the newsletter editor for the professional polish that makes the articles so accessible.

This special publication of the Northern Virginia Mineral Club reprints articles on Minerals of the Month from January 2016 to October 2019 so that club members can easily find a particular mineral. Updates will follow annually. The minerals appear in alphabetical order, with page numbers listed below.

*Hutch Brown, Newsletter Editor*

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## Adamite

by Sue Marcus

Source: *The Mineral Newsletter*, March 2018.

Our March mineral, adamite, can be green like a shamrock, although it also comes in many other colors. Many of us are lucky enough to have an adamite or two in our collections.

The first specimens of adamite came from the Atacama region of Chile, which has produced many unique minerals. The French mineralogy professor Charles Friedel (1832–1899) described the original material in 1866, naming the mineral after Gilbert-Joseph Adam. Adam, a financial official in the French government, was an avid mineralogist and collector who provided the original samples to Friedel. Adam discovered the first specimens of several other minerals as well.

Since the original material was described, better sources have been found in Mexico. Many of us have pieces from the famous Ojuela Mine in Mapimi, Durango, Mexico, in our collections. These specimens are known for lustrous crystals in various shades of green on a rusty, crumbly limonitic matrix, displaying a contrast of colors and textures.

Interestingly, this locality is also the source of most of the beautiful purple-hued cobaltianadamite crystals. I don't know of any specimens with both green and purple crystals on the same specimen.

Most adamite specimens from Durango fluoresce green in long- and short-wave ultraviolet light. White, yellow, and yellow-green fluorescence have also been reported. Phosphorescence, when present, is brief. Adamite from Durango forms "wheatsheaves" or bow ties and radiating crystals, similar to Indian stilbite.

Fine adamite specimens have also been extracted from the mines in Tsumeb, Namibia. These are generally deeper, darker green than the Mexican material.

Older classic localities include Lavrion, Greece, and Garonne, France. The Lavrion adamite is usually either clear or more aqua than the green to yellow-green Durango adamite. Also, the Lavrion matrix is different and lighter colored than the Durango matrix, and the Lavrion crystals are more likely to be tiny (micros), though exquisitely formed. Larger specimens of Lavrion adamite seem to usually have botryoidal forms. The Garonne adamite assumes a broad range of colors,



**Top/center:** Adamite from the Ojuela Mine, Durango, Mexico.  
Photos: Bob Cooke. **Bottom:** Adamite from Attiki, Greece.  
Source: Wikipedia; photo: Rob Lavinsky.

although specimens rarely exceed 1 centimeter in diameter.

More recently, excellent crystals have come from Dal'negorsk, Russia, and Nandan, China. Some of the Chinese specimens look like the ones from Durango,



**Top:** Adamite from the Ojuela Mine, Durango, Mexico.  
**Bottom:** Adamite from Gold Hill, UT. Photos: Bob Cooke.

both in coloring and in limonite matrix; the Nandan specimens also fluoresce like those from the Ojuela Mine. Photographs of adamite from the Brenner Mine in Dal'negorsk, Russia, remind me of Kelly Mine smithsonite. The Mindat images show gorgeous botryoidal aqua masses flowing over their matrix.

The United States isn't known for stellar adamite specimens. The best U.S. crystals come from Gold Hill in Toole County, UT, west of Salt Lake City, near the Nevada border.

Adamite is a minor zinc ore. It forms in the secondary, oxidized cap of primary mineral deposits that are rich in zinc and arsenic. Iron and manganese oxides, along with quartz, are the hosts for adamite, which is usually associated with some combination of smithsonite, olivenite, hemimorphite, and calcite.

I have mentioned "splitters" and "joiners" in other articles about the Mineral of the Month. Splitters pop up in broad discussions of adamite, too. Iron in the usual adamite crystal lattice (structure) colors adamite green.

Added copper may become significant enough to form the variety called cupriadamite or cuproadamite  $((Zn,Cu)_2(AsO_4)(OH))$ , but I don't know at what exact point the split comes. Add cobalt (cobaltianadamite— $(Zn,Co)_2(AsO_4)(OH)$ )—and the crystals are lovely purple, particularly at their tips or terminations.

I won't go into all the other splits except to note that Mindat mentions manganoan adamite, nickeloan adamite, alumino adamite, and the adamite-olivenite series. Zinc substitutions in the lattice can change the mineral to a zinc arsenate—tarbuttite—rather than adamite (again, I can't identify the point of change).

Adamite is not a practical gemstone due to its relative softness. Crystals are also seldom large enough to be faceted. If there is a chance, someone will try, so adamite has been faceted. The largest cut stone I could find mentioned is 4.61 carats from Durango. All the photos of cut adamite that I could find showed translucent, not transparent, cut stones. Adamite cleaves easily, which would add to the challenges of faceting or creating cabochons.

*Note:* When researching this article, I learned that adamite has two meanings: one concerns the mineral and is used here; the other is for a religious sect. Not here!

### Technical Details

Chemical formula.....	$Zn_2AsO_4OH$
Crystal form.....	Orthorhombic
Hardness.....	3.5
Density.....	4.32–4.48 g/cm <sup>3</sup> (measured)
Color.....	Usually shades of green, from yellowish-green though pure green to blue-green; also yellow, white, colorless, purple, dull orange to brown, rarely red
Streak.....	Usually white; less frequently light green
Cleavage.....	One good cleavage
Fracture.....	Uneven to subconchoidal
Luster.....	Vitreous ↗

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## Anglesite

by Sue Marcus

Source: *The Mineral Newsletter*, February 2019.

Most people don't think of lead as particularly attractive and definitely not as transparent. Our Mineral of the Month for February, anglesite, is a lead sulfate mineral that is often found in transparent crystals. Perhaps more importantly, it can usually be purchased at prices allowing for it to be included in most collections.

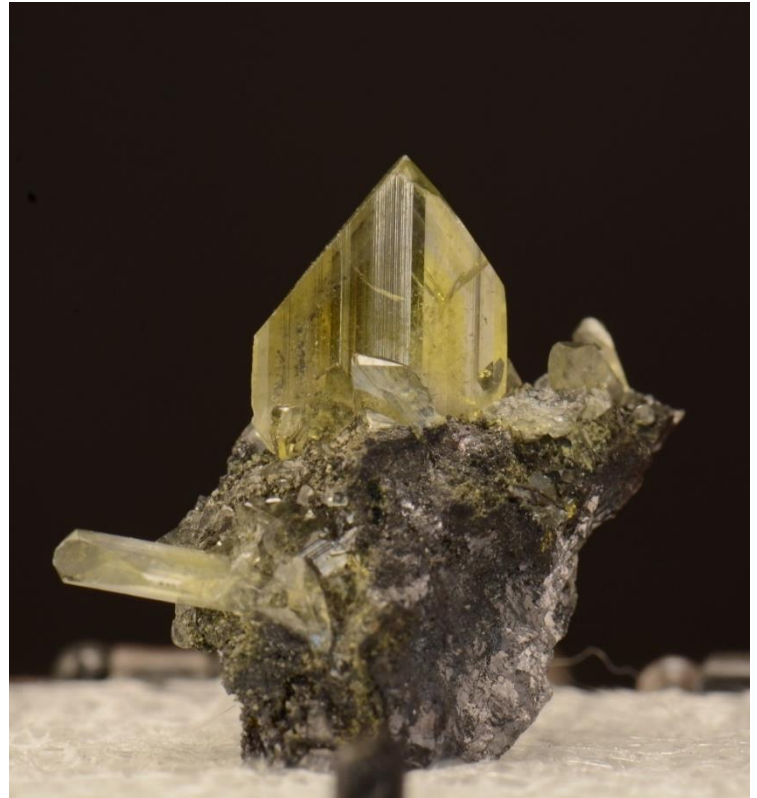
Anglesite was discovered by the English naturalist William Withering (for whom the mineral witherite was named). Withering first described anglesite in 1783 on the island of Anglesey in the Irish Sea off Wales, but the mineral was actually named by the French mineralogist F.S. Beudant in 1832.

The Parys Mountain Mines (Mona Mine) on Anglesey are the type locality for anglesite. The area was a major copper producer in the 18th century, although it has produced copper at least since the 16th century and possibly since the Bronze Age. According to Mindat—an amazing resource—the mine area has been a filming location for the science fiction television series *Dr. Who!*

Anglesite is usually a secondary mineral formed from the breakdown or degradation of galena or other lead ores. Sometimes, this chemical reaction is incomplete, leaving galena inclusions in anglesite and making the anglesite appear gray or translucent. In other cases, anglesite and galena may be banded.



Anglesite from Touissit, Morocco.  
Photo: Bob Cooke.



Anglesite from Touissit, Oujda-Angad Prefecture, Morocco.  
Photo: Bob Cooke.

Since it is a secondary mineral, anglesite can also form pseudomorphs after galena or, less frequently, cerussite. Anglesite crystals, notably the ones from Morocco and Namibia, seem—at least to me—to form wedges or spear shapes.

The heavy weight of anglesite, caused by its lead content, help distinguish anglesite from most other minerals. Though similar to cerussite, anglesite doesn't form the reticulated intersecting crystals of cerussite. (Compare photos of the two minerals on Mindat—or see the article on cerussite below.) Other lead ores are more abundant, although anglesite has been mined for lead when found in sufficient quantities. The United States imports and exports lead, primarily for use in batteries.

The specimens I've seen (in photographs) from the Welsh type locality are relatively small and either white or colored brown by limonite. At the other end of the collectable spectrum are the sharp, lustrous crystals from Touissit, Morocco. Many of these stand out from the matrix and are so large and transparent that you could read through them.



*Anglesite from Tsumeb, Namibia.  
Photo: Bob Cooke.*

My favorites are the medium yellow ones. Tsumeb, Namibia, is known for a long list of superb crystalized minerals, anglesite among them. The Tsumeb specimens are usually more compact, lacking the clear “spear tip” of the Moroccan crystals. Broken Hill, Australia, is another major mine that has produced nice anglesite specimens. The Montaponi Mine in Italy produced some lovely specimens, though with smaller crystals than the previously named sources. Mexican deposits have produced some specimens, although Mexico has not been a major specimen producer.

Unfortunately for collectors in the United States, our country is not known for exceptional anglesite. Idaho’s Bunker Hill Mine produced collectible specimens, though not of the same caliber as specimens from Touissit or Tsumeb. For a free show, Mindat offers 1,647 photos of anglesite!

Since anglesite is soft and made of lead, it isn’t useful as a cut stone, although it is attractive. Some gem cutters like a challenge or a rare stone to cut, so anglesite is occasionally cut into faceted stones. If you try this, remember: it is a lead mineral, so take suitable precautions! A lovely lemon-yellow faceted stone from Tsumeb, weighing 51.33 carats, is the largest one shown on the Gemdat website.

**Collector alert:** Minerals.net informs us that deep amber-colored anglesite from Morocco has been artificially treated by bleaching light-yellow specimens.

### Technical Details

Chemical formula .....  $PbSO_4$   
Crystal form ..... Orthorhombic



*Anglesite from the San Felipe Mine, Sonora, Mexico.  
Photo: Bob Cooke.*

Hardness ..... 2.5–3  
Specific gravity ..... 6.3–6.4  
Color ..... Colorless through white, gray, and yellow; more rarely green, blue, or violet  
Streak ..... White  
Cleavage ..... Good; 2+ cleavage planes  
Fracture ..... Conchoidal  
Luster ..... Adamantine (earthy when forming crusts)  
Fluorescence ..... Often yellow (short-wave)

### Acknowledgments

I would like to acknowledge the helpful review and additions by my husband, Roger Haskins, and supreme editor Hutch Brown for his skillful editing.

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## Arsenopyrite

by Sue Marcus

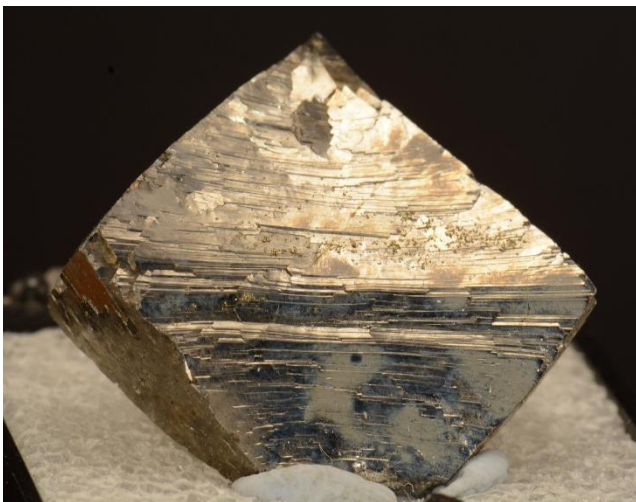
Source: *The Mineral Newsletter*, November 2018.

The name arsenopyrite gives us clues to this mineral's chemistry. Yes, it is an arsenic mineral, the most common arsenic-bearing mineral in the world. Chemically, pyrite is  $\text{FeS}_2$ . Arsenopyrite is  $\text{FeAsS}$ , so arsenic substitutes for some of the sulfur. This also lends this month's mineral a nickname of arsenical pyrite.

The German mineralogist Ernst Friedrich Glocker gave this mineral its official name in 1847, based on the contraction of arsenical pyrite. The derivation of arsenic originates in the Persian *zarnikh* and Syriac *zarniqa*, which became the Greek *arsenikon* (meaning masculine or potent), which then evolved to Latin *arsenicum*, then old French *arsenic*, from which we have modern English *arsenic*. Mispickel is another term for arsenopyrite, still used in Germany and France.

Pyrite is in the isometric system, forming cubes, pyritohedrons, and so forth; arsenopyrite is monoclinic, occurring as twinned crystals in dipyrramids, coxcombs, and other forms.

Arsenopyrite is described as silvery white, although many lovely specimens are more bronze due to tarnish. Think of the color of fresh, gleaming metallic pyrite; now add some silver tones to it. That's what the color (not the shape or morphology) of lustrous arsenopyrite is like. When tarnished, it may still be lustrous but darker and more bronze. In photographs, the color may also be in the art of the photographer!



Arsenopyrite from Santa Eulalia, Chihuahua, Mexico. Photo: Bob Cooke.



Arsenopyrite from the San Antonio Mine, Chihuahua, Mexico. Photo: Bob Cooke.

Although arsenopyrite can be found in all three major rock types (sedimentary, igneous, and metamorphic), it is most commonly found in metamorphic contact zones, like the ones that host major metallic mineral deposits in China; or in high-temperature igneous systems, like those in Panasqueira, Portugal. Arsenopyrite in organically derived sedimentary deposits is seldom interesting to collectors.

Butte, MT, was a domestic source of arsenopyrite. Tarnished euhedral crystals came from the old Carmel, NY, locality. Places known for cobalt (like Cobalt, Ontario) host arsenopyrite too. For the past decade or so, the sulfide deposits of Peru and Bolivia have been sources of excellent arsenopyrite specimens at all prices, along with the other sulfide minerals they have produced or are producing. More recently, the famous Huanggang and Yaogangxian mines in China have produced the best specimens on the market.

In Europe, the classic localities of Freiberg, Germany, and the Cornish mines in England are among the mostly past sources of arsenopyrite. The mines of Panasqueira, Portugal, are still active and, in conducting web research for this article, I saw new, well-crystallized arsenopyrite specimens from this locality.

Circling back to this hemisphere, Mexico also produced arsenopyrite, most notably from the Santa Eulalia (Chihuahua) and Zacatecas regions.



*Arsenopyrite, Canchaque Mine, Ancash, Peru.  
Photo: Bob Cooke.*

From Geology.com, I learned that arsenopyrite oxidizes to scorodite ( $\text{Fe}^{3+}\text{AsO}_4 \cdot 2\text{H}_2\text{O}$ ). Since arsenopyrite is relatively abundant, I wonder why scorodite is relatively rare. That's a question for another day, but I invite your research and information on this.

Other Mineral of the Month articles have mentioned solid solution series, that is, the chemistry of minerals in which elements substitute for one another to form related but different minerals, with the amounts of substitution varying between the endpoints of the series. Arsenopyrite ( $\text{FeAsS}$ ) forms a solid solution series with glaucodot ( $(\text{Co},\text{Fe})\text{AsS}$ ), with a bit of cobalt added to the basic arsenopyrite formula. Unlike arsenopyrite, glaucodot is rare, found in specimens that most collectors would cherish.

Gudmundite ( $\text{FeSbS}$ ) and danaite ( $(\text{Fe}_{0.90}\text{Co}_{0.10})\text{AsS}$  –  $(\text{Fe}_{0.65}\text{Co}_{0.35})\text{AsS}$ ) are related to arsenopyrite. Mindat lists danaite as a variety of arsenopyrite rather than a separate species, along with a couple of rare, related, ruthenium-bearing species.

Arsenopyrite can include minor amounts of gold. Even those minor amounts may be worth recovering. Auriferous pyrite and arsenopyrite are autoclaved in large rotating kilns, which oxidize the pyrites and drive off the arsenic as a gas. The arsenic and sulfur are condensed into solids and sent out for disposal. The gold-iron residue is further processed through cyanide leach and carbon removal.

When arsenopyrite dissolves in nitric acid, the chemical reaction releases arsenic and sulfuric acid, both toxic materials. Both are useful but abundantly available. Despite its affinity for gold, arsenopyrite is not a favorite mineral for miners and mining companies because it presents disposal problems. Sulfur can be sold to chemical plants, but the market for arsenic is limited.

Best known as a poison, arsenic has many uses, including as a pesticide and herbicide (check labels and use carefully) and in weapons—a real killer! Arsenic can be used as a colorant in fireworks and pigments. It has been used in hardening munitions, a use that has been largely phased out. Similarly, the use of arsenic in medicines is less frequent now, although it still finds use in some cancer treatments.

The garlic odor distinctive of arsenic-bearing minerals helps collectors and geologists alike identify arsenopyrite. However, the smell is evident when the rock or specimen is struck by a hammer, so don't try this *before* making a purchase.

Do I need to mention that arsenopyrite is not a gemstone? Don't wear it! And wash your hands after handling any specimens.

### Technical Details

Chemical formula.....	$\text{FeAsS}$
Crystal form .....	Monoclinic
Hardness .....	5–6.5 (sources vary)
Density .....	5.9–6.2 (sources vary)
Color.....	Slivery gold (fresh); Bronze, brown (tarnished)
Streak.....	Black, gray
Cleavage.....	Poor to good (sources vary!)
Fracture .....	Irregular
Luster.....	Metallic

### Acknowledgment

I would like to acknowledge the helpful review and additions by my husband, Roger Haskins. ↗

## Barite

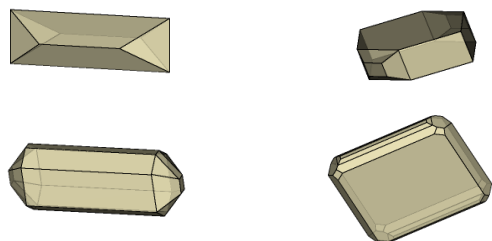
by Bob Cooke

Source: *The Mineral Newsletter*, January 2019.

January's mineral of the month is barite. According to the International Mineralogical Association, the accepted spelling is "Baryte;" but in the United States, we continue to spell it "barite." The pronunciation is the same.

Chemically, barite is barium sulfate— $\text{BaSO}_4$ . Barite is an analogue of both celestine and anglesite; replace the barium with strontium, and you get celestine; replace it with lead, anglesite.

All three minerals are in the orthorhombic crystal class, with three axes at right angles to each other but each of a different length. Hence, a rectangular prism. Different crystallization conditions, however, can favor the development of a particular prism or termination face to produce variations such as:



Color is one of the least accurate ways to identify a mineral. Barite proves the point—it can be in colorless, white, yellow, brown, gray, and blue crystals. Its luster is vitreous (like glass). Its hardness on the Mohs scale is 3.

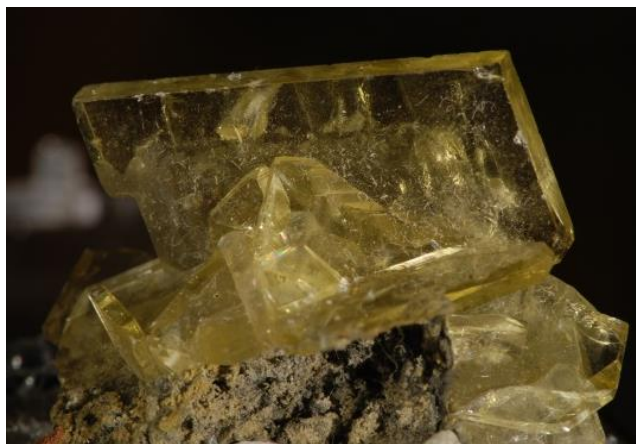


Barite from the Sidi Lachen Quarry, Nador, Morocco.  
Photo: Bob Cooke.

Barite was named in 1800 by the German mineralogist Dietrich Ludwig Gustav Karsten from the Greek word βάρυς ("heavy"). It is indeed unusually heavy for a nonmetallic mineral, with a specific gravity of 4.5.

Barite often occurs as concretions and void-filling crystals in sediments and sedimentary rocks. It is especially common in limestone and dolostone formations. Where these carbonate rock units have been heavily weathered, large accumulations of barite are sometimes found at the soil–bedrock contact. Many commercial barite mines produce from such residual deposits.

Barite is also found as concretions in sand and sandstone. The concretions grow as barite crystallizes



Barite comes in multiple colors, including orange (left, from the Red Hill Pit, Emerson, GA) and yellow (right, from the Meikle Mine, Elko County, NV). Photos: Bob Cooke.





*Barite from Paraiba, Brazil. Photo: Bob Cooke.*

within the interstices between sand grains. Sometimes, crystals of barite grow into interesting shapes within the sand. These structures are known as barite roses (see photo at right). They can be up to several inches in length and incorporate large numbers of sand grains. Occasionally, barite is so abundant in a sandstone that it serves as the “cement” for the rock.

Barite is also a common mineral in hydrothermal veins and is a gangue mineral (matrix material) associated with sulfide ore veins. It is found in association with ores of antimony, cobalt, copper, lead, manganese, and silver. In a few locations, barite is deposited as a sinter (hard sulfide deposit) at hot springs.

So what is barite used for (when it’s not being appreciated for its crystal beauty)? Ninety-nine percent of the barite consumed in the United States is used as a weighting agent in drilling muds. These high-density muds are pumped down a drill stem and through the cutting bit (cooling the bit in the process). The rock cuttings float on the heavy mud, and it’s all flushed back to the surface.

Barite can be used as a pigment in paints. Due its heavy weight, it is also used as a weighted filler for paper, cloth, and rubber. Some playing cards have barite packed between the paper fibers to give the paper a higher density, allowing the cards to be more easily shuffled and dealt.

Barite is the primary ore of barium, which is used to make a wide variety of barium compounds. Because of barium’s high atomic mass, it makes a good shield against gamma rays and x-rays. When incorporated

into concrete construction in hospitals, power plants, or laboratories, barite is a safety feature for blocking x-ray emissions.

Barite compounds are also used in diagnostic medical tests. An x-ray image of a patient who has just introduced a barium compound into his or her digestive track will reveal the location of the barium with high resolution and provide information about the condition of the digestive tract. Without the barium, there would be no contrast between the digestive track and surrounding tissues.

In 2015, worldwide production of barite was approximately 7,400 metric tons. China produced 3,000 tons and India and Morocco 900 tons each. The United States was considerably far down the list of producers, at only 500 tons. ↗

### Sources

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Mindat.org. 2018. [Baryte](#).



*Barite rose from Cleveland County, OK. Photo: Bob Cooke.*

## Bornite

by Sue Marcus

Source: *The Mineral Newsletter*, September 2018.

Most of us have heard of bornite (or “peacock ore”), although fewer have crystals of this mineral in our collections. Oxidized bits of bornite are common, but nicely crystals are rare. And glittering, iridescent hunks of “bornite” might actually be chalcopyrite treated with acid for the attractive, salable tarnish.

In 1845, Wilhelm Karl von Haidinger named the mineral after Ignaz von Born (whose original Hungarian name was Born Ignác). Previously, bornite had several multiword German names, such as the 1791 name *Buntkupfererz* (“multicolored copper ore”). Mindat provides the type (original) locality in Bohemia as Jáchymov (Sankt Joachimsthal), Jáchymov District, Krušné Hory Mts. (Erzgebirge), Karlovy Vary Region, Czech Republic. The area was largely German-speaking at the time, hence the German place names.

Bornite is usually emplaced when igneous or metamorphic events introduce ascending hot fluids into newly forming rocks. Bornite occurs much less frequently in sedimentary rocks—typically in shales. Isometric crystals form at high temperatures but retrograde to orthorhombic forms.

Bornite is a primary copper ore containing up to 63 percent copper, so most of it is ground up and fed into the crusher for processing. It is relatively common, massive, and uncommon as crystals. It weathers to chalcocite and other secondary minerals. Butte, MT, was a noted source of massive bornite and rare crystalized specimens when the mine there was active. Arizona copper mines produced massive specimens.



Bornite on silver from Zacatecas, Mexico. Photo: Bob Cooke.



Bornite on quartz from the Dzhezkazgan Mine, Kazakhstan. Photo: Bob Cooke.

Well-formed crystals are noted from Dzhezkazgan, Kazakhstan, as well as Congo, Zaire, and Zimbabwe. Older crystalized specimens were extracted from the mines in Cornwall, England.

Because bornite is a heavy, brittle metal, it is not a gemstone. Wide wrapping or putting unworked pieces of tarnished “peacock ore” into jewelry is possible, but the copper content can leave green stains on garments and the people wearing them. ↗

### Technical Details

Chemical formula.....	Cu <sub>5</sub> FeS <sub>4</sub>
Crystal form .....	Orthorhombic
Hardness .....	3–3.5
Density .....	4.9–5.3 (avg. 5.09? sources vary)
Color.....	Fresh surfaces: reddish (copper) brown; exposed surfaces: iridescent, degrading to black with length of exposure
Streak.....	Dark gray-black
Cleavage .....	None
Fracture.....	Conchoidal; none (sources vary)
Luster.....	Metallic

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## Cassiterite

by Sue Marcus

Source: *The Mineral Newsletter*, April 2019.

Cassiterite is a simple mineral, isn't it—simply tin and oxygen,  $\text{SnO}_2$ ? I usually learn something while researching these articles. I hope that we can learn about this Mineral of the Month together.

### Name Origin

The first rocky problem comes from the derivation of the name. Various sources offer *kassiteros* (Greek for tin) or *Cassiterid* (Phoenician for the British Isles, a likely early source of tin). There are ancient tin mines in Cornwall, England, but some references indicate that islands off Spain gave cassiterite its name. (What islands? Anyway, none have tin!) Another source suggests that the mineral was named for the people and region of Kassites in Iran.

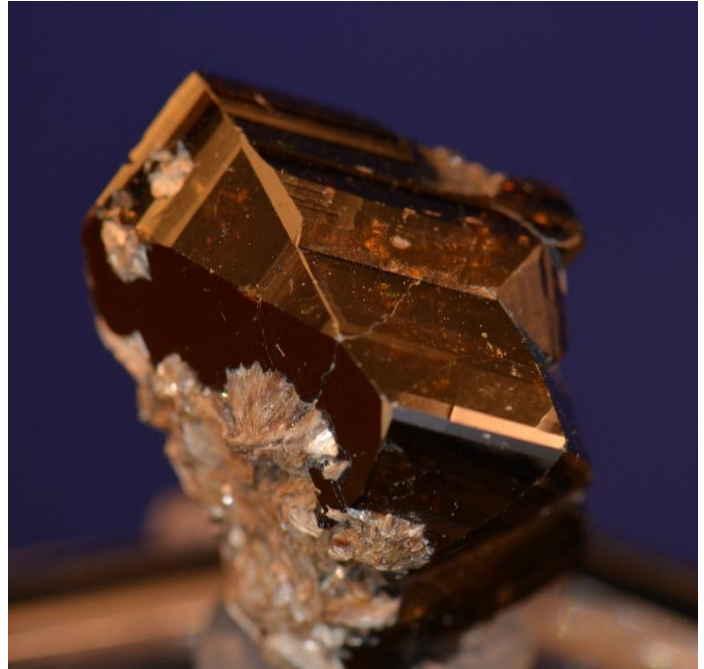
Copper and tin are required to make bronze, one of the earliest multiple-use metals, so I tend to believe the Cornish reference.

### Mining History

Tin, probably in the form of cassiterite, has been mined since about 2500 BCE. The earliest known mines were in southwestern England, roughly contemporaneous with mines in the German *Erzgebirge* (literally, “Ore Mountains”), which now straddle the border between



*Cassiterite and siderite on quartz, from the Panasqueira Mines, Covilhã, Castelo Branco District, Portugal. Photo: Bob Cooke.*



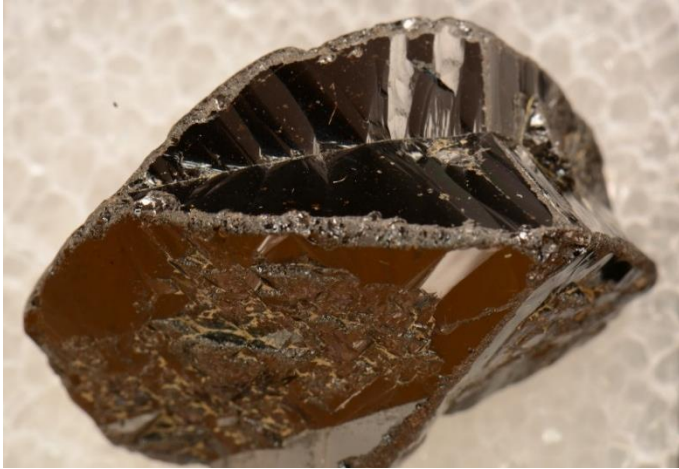
*Cassiterite from Elsmore, New South Wales, Australia. Photo: Bob Cooke.*

Germany and the Czech Republic. Through trade, cassiterite deposits in these locations were exploited by the Phoenicians and Greeks, followed by the Romans (through conquest in addition to trade). Other ancient sources of cassiterite were mined in Brittany, the Iberian Peninsula, and the Balkans.

In Asia, few cassiterite deposits were known to early miners. Excavations began during the early Bronze Age at a large surface and underground mine in Kestel, Turkey. The deposit was relatively low grade but worth mining since the commodity was relatively rare and very useful. Small cassiterite deposits were also mined along the Yellow River during the Chinese Bronze Age.

So you see, cassiterite isn't so simple after all, at least not in terms of its history.

Cassiterite, as the primary early tin ore, drove early world trade. Copper was useful but soft; adding tin made it harder. Arsenic could also be used as an alloy to harden copper, but arsenic's toxicity was obvious to users—or to their surviving colleagues and heirs. Extremely early bronze objects are reported from Pločnik, Serbia, dating from 4500 BCE. Bronze, the copper–tin alloy, was the hardest metal known to the ancients. Tin, as a principle ingredient, was therefore a prized commodity.



*Cassiterite from Minas Gerais, Brazil. Photo: Bob Cooke.*

Tin was probably shipped from small deposits in central Asia over the Silk Road or sent from the European or Asian mines to foreign processing facilities. Tin ore could remain closer to its source when copper was imported for bronze manufacturing. Ancient Mediterranean shipwrecks have been found carrying copper ingots, probably on their way to becoming bronze objects, indicating that copper may have been transported to tin-bearing sites.

Tin mining is part of the history of Cornwall. Many rare minerals were found in the Cornish tin mines, and the region was recognized in 2006 as a UNESCO World Heritage Site for its mining history. The last mines closed in 1998, following a price crash a decade earlier. None of the mines could survive the struggle to remain economically viable.

### **Specimens and Sources**

Cassiterite can form in several ways. “Wood tin” forms in low-temperature surficial hydrothermal systems, with matrix-based, radiating crystals that have alternating bands of color, roughly resembling wood. Cornwall, England, and the Malyi Khingan Range, Russia, are among the sources of wood tin. Placer cassiterite deposits are currently mined using hydraulic methods in Malaysia, Thailand, Indonesia, Somalia, and Russia. Hydraulic mining is environmentally destructive, using large quantities of water and adding sediment to the waterways.

Cassiterite is hosted in stanniferous (tin-bearing) granites, some of which may have hydrothermal veins richer in cassiterite. The Cornish mines extracted tin

from these enriched veins, and Bolivia continues mining similar tin-bearing geologic systems.

Bolivia is also known for its lustrous, classic cassiterite mineral specimens, usually from the Departments of Oruro or Potosí. Crystals are deep brown, often on matrix. The Brazilian pegmatites have also been a minor source of cassiterite crystals.

China has been exporting an abundance of collectible minerals, and cassiterite is part of this cornucopia. Mt. Xuebaoding in Sichuan Province and the Yaogangxian in Hunan Province are tungsten–tin mines that have produced nice cassiterite specimens, along with other mineral species. The show stoppers, which I’d never seen until I looked for them for this article, are the transparent to translucent specimens from Ximeng, Yunnan Province, China. They can be huge—and still be transparent! I could not find any images for the white cassiterite, reportedly from China, nor any images of what I would consider white cassiterite at all, other than bands in massive, wood-tin-type material.

Khabarovsk Kray, Russia, has produced attractive wood tin and cassiterite crystal specimens reminiscent of the Bolivian ones. Moving to Europe, Bohemia (Czech Republic) and Saxony (Germany) were some of the original specimen producers. Nice, classic specimens, though never plentiful, have also come from France and Spain.



*Cassiterite twin from the Erongo Mountains, Erongo Region, Namibia. Photo: Bob Cooke.*

Australia's Elsmore Mine in New South Wales was active in the late 19th century, when lustrous, fine cassiterite specimens were extracted. Apparently, an Australian mineral club had (but lost) a lease on the property in the late 20th century. Perhaps less well known, the Aberfoyle Mine in Tasmania was worked until the 1970s, with cassiterite crystals found—and possibly later found on the dumps. If you are going to Tasmania, collecting on those dumps may still be possible.

The Morefield Mine in Amelia County, VA, has produced cassiterite, though not of the spectacular quality—or quantities—found elsewhere. Other U.S. deposits are similarly limited, with rare specimens found in Maine and New Mexico.

### Commercial Production

China is the world's largest tin producer, with Indonesia not far behind. Indonesia is the primary source of tin for the United States. The U.S. Geological Survey notes that U.S. tin resources, mostly in Alaska, are insignificant.

Tin is used in this country for tinplate—steel coated with a thin layer of tin for corrosion resistance, ease of welding, and luster (as in “tin” cans). Tin is also used in chemicals, solder, alloys, and other manufactures.

### Lapidary Use

Wood tin may be cut into lovely, unusual cabochons. Most cassiterite is opaque and would not make an attractive faceted gem. When it is faceted, it is mostly as a novelty. It is quite brittle. “Andean diamond” is a name for faceted Bolivian cassiterite!

### Technical Details

Chemical formula .....	SnO <sub>2</sub>
Crystal form .....	Tetragonal
Hardness .....	6–7
Specific gravity .....	6.8–7.1
Color .....	Brown to black; extremely rarely red, yellow, or colorless
Streak .....	Light brown to white
Cleavage .....	Imperfect; indistinct, poor
Fracture .....	Uneven to subconchoidal
Luster .....	Adamantine in best crystals, dull in wood tin



*Cassiterite from the Inverell District, New South Wales, Australia. Photo: Bob Cooke.*

### Acknowledgments

I would like to acknowledge the helpful review and additions provided by my husband, Roger Haskins, and editor Hutch Brown for his skillful editing.

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## Cerussite

by Mike Kaas

Source: *The Mineral Newsletter*, November 2017.

Cerussite is a secondary lead carbonate mineral, a member of the Aragonite Group. It is found in oxidized zones of lead and polymetallic ore deposits, usually as a weathering product of galena and/or other lead ore minerals. It was named in 1845 by Wilhelm Karl von Haidinger from the Latin word *cerussa*, meaning “white lead.” The type locality is Vicenza Province, Veneto, Italy.

### Uses and Sources

Although the toxic properties of lead frequently make the headlines or “go viral” on social media, lead has many safe and essential uses, not least in the manufacture of automobile batteries (which are recycled at the end of their useful life) and in the lead coverings used for radiation protection—remember the last time you had an x-ray?

The Tsumeb Mine in Namibia produced a large quantity of fine cerussite specimens from its oxidized ore zones. The upper levels of the Broken Hill Mine in Australia also produced excellent specimens. In the United States, many specimens have come from the Bunker Hill Mine (Kellogg, ID); the Mammoth Mine (Tiger, AZ); the Campbell Shaft (Bisbee, AZ); and the Wheatley Mine (Phoenixville, PA).



Cerussite from the Tsumeb Mine in Namibia. Malachite tints the clear cerussite green; the gold is mimetite.  
Source: Wikipedia; photo: Rob Lavinsky, iRocks.com.



Cerussite from the Tsumeb Mine in Namibia.  
Source: Wikipedia; photo: Rob Lavinsky.

### Virginia Occurrence

Leonard Watson, in his *Lead and Zinc Deposits of Virginia* (see the excerpt below), described the cerussite found in the 1800s at the Wythe Lead and Zinc Mines at Austinville in southwestern Virginia (Watson 1905). Although galena was the primary lead mineral at Austinville, the density of the cerussite would have attracted the miners’ attention.

Unfortunately, few specimens have survived. Following the Civil War, zinc became the primary product of the mines at Austinville. ↗

*Cerussite.*—This is lead carbonate and it is also known as white lead ore. It is a secondary mineral derived from the alteration of galenite in the zone of oxidation. When chemically pure cerussite contains 83.5 per cent. of metallic lead. It has been noted in more than a trace only at one locality in the State, namely, the old Wythe Lead and Zinc Mines at Austinville, in Wythe county, where it is not an altogether uncommon ore among the altered forms.

It occurs distributed through the residual clays of the limestone as stringers and small irregular masses. The earthy form greatly predominates. As such the clayey admixture is readily identified by its weight, specific gravity. Crystals grouped in clusters and aggregates of white and light grayish color, distributed through the clay, are not uncommon. It further occurs as a white powder-like coating on the crystals and masses of granular galenite.

## Technical Details

Chemical formula..... $\text{PbCO}_3$   
Crystal form .....Orthorhombic  
Moh's hardness .....3–3.5  
Density .....6.5–6.6  
Color .....Clear, white, gray, blue, light  
yellow, or green  
Streak .....White  
Cleavage.....Good  
Fracture .....Conchoidal  
Luster .....Adamantine, vitreous,  
resinous, pearly, dull, earthy

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*Light of the Desert, the world's largest faceted cerussite, located in the Royal Ontario Museum, Toronto, Canada. Source: Wikipedia.*

## Chalcedony

by Hutch Brown

Source: *The Mineral Newsletter*, January 2016.

With my interest in geology, I like common rocks that show up in interesting ways and places. So I like quartz in all its variations.

One of them is chalcedony, which got its name from the ancient Greek town of Chalcedon in what is now Turkey. The Roman naturalist Pliny the Elder (23?–79 AD) mentioned chalcedony in his *Naturalis Historia*.

In the general sense of the term, chalcedony is cryptocrystalline quartz, meaning that it has microscopic crystals. By contrast, macrocrystalline quartz forms visible quartz crystals as well as massive quartz veins and lenses.

Most chalcedony is actually an intergrowth of tiny crystals of quartz and moganite, a polymorph of quartz that gradually degrades into quartz. Chalcedony contains 1–20 percent moganite. (It is all silicon dioxide.)

Chalcedony has many varieties, including agate, chert, jasper, onyx, sard—even petrified wood. Among other occurrences, it appears as fossilizing material; as cement in sandstones; as layers and nodules in limestones and marls; and as veins and nodules in volcanic rock. For example, when silica-rich brines fill gaps in volcanic rock, the silica precipitates out, filling the gaps with chalcedonies (such as agate) containing trace amounts of water.

Chalcedony has a waxy luster and appears vitreous when polished. Like quartz, it belongs to the trigonal crystal system. With a hardness of 6.5 to 7, chalcedony comes in many colors, depending on the impurities it contains. Under short-wave ultraviolet light, chalcedony often turns green.

In the narrow sense of the term, chalcedony does not include banded colorful varieties such as agate. Instead, it is limited to botryoidal forms, meaning rounded masses, usually white to blue or gray. The specimen on the right is an outstanding example, bluish gray in color. The engraver used the waxy, rounded form typical of this mineral to depict a side view of the human head in stunningly beautiful detail (on translucent onyx). ↗.



*Chalcedony cameo.*

Source: Smithsonian Gem Gallery; photo: Chip Clark.

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## Chrysocolla

by Sue Marcus

Source: *The Mineral Newsletter*, May 2019.

May's mineral of the month is chrysocolla. It is a slippery mineral, though not in the literal sense. Chrysocolla varies in color, usually from aqua to green, often in the same specimen. The mineral's hardness can vary too, depending on how much the rock has been silicified (permeated with silica).

Chrysocolla is rarely expensive, with pieces readily available for \$20 or less. While browsing the Internet, I found a couple of large pieces priced at more than \$200, but that is very unusual. I was amused by one source noting that their offering was "used." Higher priced specimens can have a layer of chrysocolla covered by a clear, sparkling blanket of drusy quartz.

Chrysocolla is a secondary mineral that forms as copper leaches from richer copper-bearing rocks and ores and is redeposited in a new form. It may form a thin coating or a layer several inches thick.

We now think of chrysocolla as a semiprecious gemstone, but its name comes from a former very different use. In Greek, *chrysos* means gold and *koller* means glue or solder; chrysocolla was solder for gold. The solders were a mixture of copper and other metals, and "chrysocolla" was the solder product of a recipe. The term is still used in this sense in goldsmithing and for certain gold alloys. Theophrastus first used the term in 315 BCE, relating it to goldsmithing.

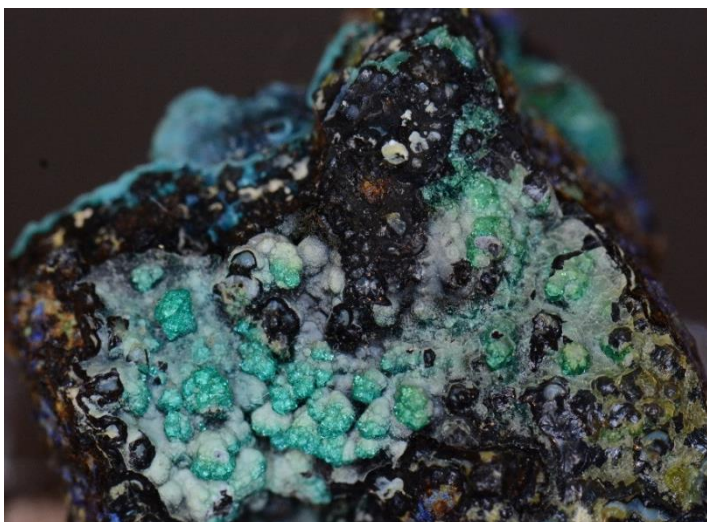


Chrysocolla from the 79 Mine, Gila County, NM. Photo: Bob Cooke.

The French mineralogist André-Jean-François-Marie Brochant de Villiersin used the term chrysocolla specifically for the mineral in 1808. (I'm glad I didn't have to sign Mr. de Villiersin's name on checks!)

All reported crystals of chrysocolla are actually pseudomorphs and not actual chrysocolla crystals. This probably holds true for reports of fibrous chrysocolla too. Webmineral.com notes that the chemical formula can vary and that the mineral can be amorphous. The water content, hardness, and color can vary even within the same specimen, a variability that adds credence to the study by Farges and others (2006) that chrysocolla is really a mixture of spertiniite and amorphous silica (opal). The authors point out that "chrysocolla might not a compositionally homogeneous mineral as is generally assumed." Maybe we have spertiniite in our collections! I could not find any further studies on this topic or confirmation of this one.

Chrysocolla typically forms botryoidal crusts, stalactites/stalagmites, or thick massive rocks. It is common, occurring with other copper minerals in prospects and major deposits. It is therefore no surprise that chrysocolla is found as nice specimens from Peru, Congo, and Arizona. Some of the specimens from Arizona and Peru display that lovely drusy quartz over chrysocolla. Cruise through the Mindat photo gallery of chrysocolla from Arizona's Ray Mine if you want a visual delight (see the Ray Mine Mindat gallery in the sources below). The Whim Creek copper mine in Western Australia has produced nice chrysocolla pseudomorphs after azurite.



Chrysocolla from Orogrande, Otero County, NM, showing the variability in color from aquas to greens. Photo: Bob Cooke.



*Chrysocolla pseudomorph after azurite from Ray Mine, Dripping Spring Mountains, Pinal County, AZ.*  
 Photo: Bob Cooke.



*Chrysocolla, botryoidal form, Planet Mine, La Paz County, AZ.*  
 Photo: Bob Cooke.

I've never seen *caveat emptor* (buyer beware) on Mindat, but when I looked up Eilat stone from Israel, I found that warning. Eilat stone is the National Stone of Israel, and it contains chrysocolla along with other copper minerals; however, green and blue rocks and stones sold in Israeli tourist shops are apparently imported from other countries.

The attractive blues and greens—and blue-greens—characteristic of chrysocolla are due to copper. Although copper is the first mineral in the chemical formula, chrysocolla is not a primary copper ore because the silica in chrysocolla makes the copper difficult to extract. Chrysocolla is primarily used for cabochons in jewelry. Some sources mention that the bluer chrysocolla tends to be softer and therefore less useful for jewelry. The harder, silicified material is preferred, often as a cheap substitute for turquoise.

Chrysocolla is also used to give a name to otherwise unnamed or hard-to-determine rocks or minerals that are green, blue, or mixes of those colors, particularly if the color is a mere coating. I hope that you, along with me, have learned that chrysocolla is harder to define and not as simple as we thought.

So, here's a final surprise: Have you heard of yellow chrysocolla? I hadn't until I started research for this article. Have a look at the corresponding Mindat photo listed in the Sources. According to Mielke (2016), the color is likely due to iron. ↗

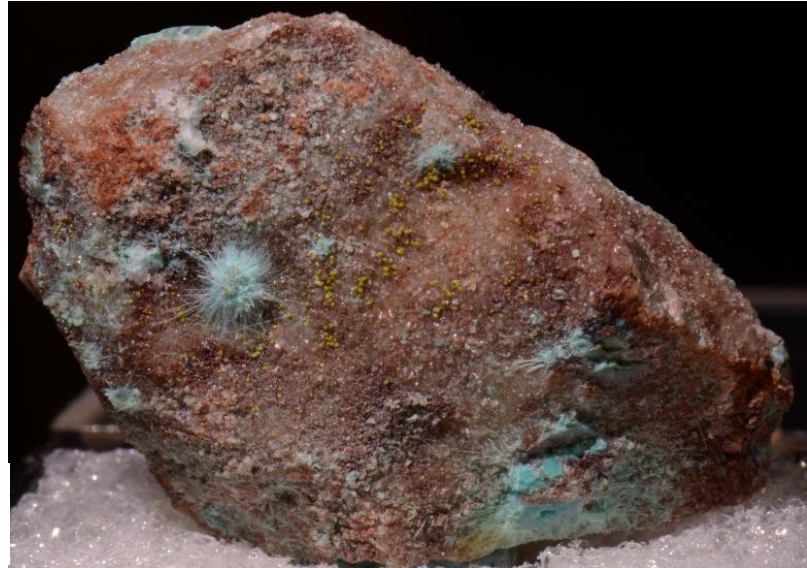
### Technical Details

- Chemical formula.....  $\text{Cu}_{2-x}\text{Al}_x(\text{H}_{2-x}\text{Si}_2\text{O}_5)(\text{OH})_4 \cdot n\text{H}_2\text{O}$ ;  $\text{Cu}_{2-x}\text{Al}_x(\text{H}_{2-x}\text{Si}_2\text{O}_5)(\text{OH})_4 \cdot n\text{H}_2\text{O}$  ( $x < 1$ )
- Crystal form ..... Orthorhombic
- Hardness ..... 2.5–3.5; 7 if heavily silicified
- Density ..... 1.93–2.4
- Color..... Blue-green (aqua), green, blue, less commonly blue-black or brown, rarely yellow
- Streak..... White to pale green or pale blue
- Cleavage ..... Irregular
- Fracture ..... Subconchoidal
- Luster..... Vitreous, earthy, waxy

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*Fibrous chrysocolla, Eagle Eye Mine, La Paz County, AZ.  
Photo: Bob Cooke.*

## Cinnabar

by Sue Marcus

Source: *The Mineral Newsletter*, October 2018.

**B**right red cinnabar looks nothing like the metal it contains, mercury (Hg). The two minerals, cinnabar and native mercury, sometimes occur together. Mercury is an odd metallic element in that it is liquid at atmospheric temperatures and pressures. Cinnabar is a beautiful, chemically simple (HgS), and very toxic mineral. Wash your hands after handling it.

Cinnabar is a mineral and material known to the ancients, and its name is shrouded in that history. Most sources believe the name is derived from the ancient Greek κιννάβαρι (*kinnabari*), alluding to the red color. Mindat suggests that the origin is from the Persian “zinjifrah,” meaning dragon’s blood. The color vermillion is associated with cinnabar.

Cinnabar is often used as an indicator for certain types of gold deposits. It forms in warm though not hot (in geologic terms) environments. Hydrothermal settings (hot springs or hot water) or epithermal settings (shallow, just below the surface) are most common for cinnabar formation. The mineral may form as vein fillings when thermal waters deposit metals as they push through cracks in the host rocks and cool.

Although cinnabar is not rare, most occurrences are massive or disseminated, so perfect crystals are unusual. They often form an attractive contrast of red and white (the matrix color) and are therefore prized by collectors. However, cinnabar darkens with exposure to light. If you have a specimen, protect its bright red color by covering it or keeping it from direct light.



*Cinnabar on dolomite. Source: Wikipedia; photo: J.J. Harrison.*

The oldest known producer of collector-quality cinnabar is southern Spain. The Almadén District has been producing mercury for two millennia, although the mines are now closed. Much more recently, stunning Chinese specimens have come onto the collectors’ market.

Start with an ogle at the photos shown here, then move on to the Mindat photo gallery or do a web search and see what’s for sale. The newer cinnabar crystals from China can be gemmy and very lustrous. So can some of the older pieces from the Almadén District in southern Spain. The contrast of the red cinnabar and white matrix in the best of these specimens is superb.

Adding to the beauty (and rarity as well as value), a few specimens show multiple twinning. One from China and one from Ukraine show what is called “drillbit” twinning: they twin around in a circle, with the tips forming the “bit.” The Redbird Mine in Nevada produced attractive specimens, though not of the same caliber or quantity as the foreign sources.

Cinnabar has been used since ancient, possibly even prehistoric, times. It was probably initially used as a pigment, providing us with the terms vermillion and Chinese red lacquer. Ritual use of mercury, possibly from cinnabar, dates to at least 1500 BC. The ancient Egyptians and Romans used cinnabar in cosmetics, while the ancient Greeks used it as an ingredient in ointments. In the New World, mercury was used by the ancient Olmec and Mayan cultures. Cinnabar has been



*Cinnabar on dolomite, Tongren Mine, Guizhou Province, China. Photo: Bob Cooke.*

used in Chinese lacquerware and consumed in traditional Chinese medicines. Qín Shǐ Huáng Dì, the first Emperor of China, may have succumbed to mercury poisoning when he was given a potion intended to give him eternal life (always read the warnings on the package—just kidding!).

Manufacturing chlorine and caustic soda are the main consumers of mercury in 2018 in the United States, followed by dental amalgam use, electronics, and fluorescent lighting.

The Spanish mines in Almadén produced cinnabar that was required for the processing of silver from Spain’s New World colonies. Peru and Mexico were also significant producers. In the United States, the McDermitt Mine in northern Nevada was the largest primary mercury producer until it closed in 1992. The United States still produces some mercury as a byproduct of gold production in Nevada.

Currently, cinnabar remains the primary mercury ore, mined in China. U.S. imports from China far exceed those from Mexico, which is the next largest producer of mercury ore. Much of the Mexican production comes from reprocessing the mines dating to the Spanish colonial period.

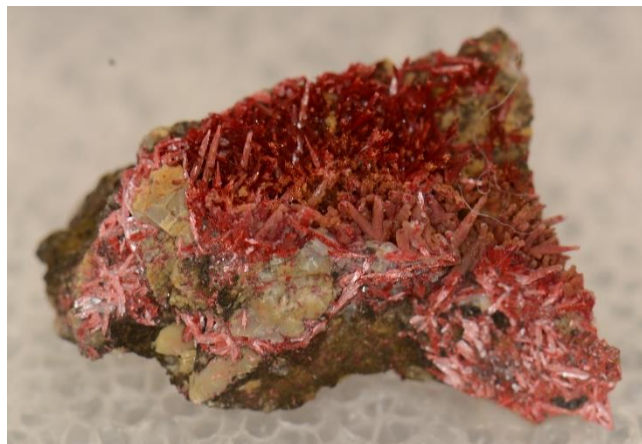
Due to its toxicity, cinnabar should not be cut or worn as a gemstone. It would be hazardous to the cutter and to the wearer. Remember that “mad as a hatter” refers to the mental condition of hatters after they used mercury in creating their products. ↗

**Technical Details**

Chemical formula .....HgS  
 Crystal form.....Trigonal



*Cinnabar, Fenghuang County, Xiangxi Prefecture, Human Province, China. Photo: Bob Cooke.*



*Cinnabar, Actua Mine, Sonoma County, California. Photo: Bob Cooke.*

Hardness ..... 2 to 2.5  
 Density ..... 8 to 8.2  
 Color..... Shades of red  
 Streak..... Red  
 Cleavage..... One perfect  
 Fracture ..... Irregular to subconchoidal  
 Luster..... Adamantine

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*Chinese carved cinnabar lacquerware, late Qing dynasty. Adilnor Collection, Sweden. Source: Wikipedia.*

## Diopside

by Sue Marcus

**D**ioptase is our mineral of the month for December—and it's a beauty, known for its distinctive green color. I hope every collector has a specimen in her or his collection—or will get one soon.

Diopside used to be rare, though known from copper deposits in several parts of the world. Namibia started sending specimens to market, initially at very high prices. The costs decreased as supply increased, and demand has always been steady for this pretty mineral. Kazakhstan has also produced gorgeous diopside specimens relatively recently, so there are options.

With more specimens available, you can obtain smaller ones—even nice ones—for relatively reasonable prices. Of course, the crystals that are large, lustrous, and undamaged still command top prices.

The famous French priest and early mineralogist René Just Haüy (known as Abbé Haüy) named the mineral “diopside” in 1797, from the Greek words *dia* (through) and *optasia* (to see), referring to the visibility of cleavage planes within translucent to transparent crystals.

The original material described by Abbé Haüy came from Kazakhstan, which has a very long history of producing collectible minerals! The best known diopside locality is probably Tsumeb, Namibia, but other



*Diopside with wulfenite from Tsumeb, Namibia.  
Photo: Bob Cooke.*

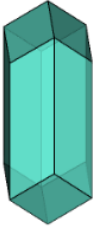
sources in Namibia and elsewhere in Africa have produced beautiful crystals. Namibia's Kaokoveld District offers attractive specimens of diopside with contrasting powder-blue shattuckite (see the photo on the right). Other sources include the Katanga (Shaba) region of the Democratic Republic of Congo (Zaire) and Renéville and Mindoula in the Republic of Congo (Brazzaville). Another notable source is the Malpaso Quarry in Córdoba, Argentina.

In the United States, diopside is found in some of the copper deposits in Arizona. The crystals are small and don't compete with those from foreign localities. But they can appeal to someone who specializes in collecting U.S. specimens or who wants to self-collect—and is lucky!

Diopside is a hydrated copper silicate. It can be mined for its copper content, but other copper minerals (like carbonates or native copper) are much less expensive to process for their copper content, so diopside is not a primary copper ore. Diopside forms in arid environments where carbonates (such as limestone and calcite) are present or chemically available. Fluids rich in sulfuric acid leach the copper in the presence of a carbonate. The copper-rich fluids can deposit diopside, given enough time for the process to occur. And if we are really lucky, we get beautiful crystals.



*Diopside with shattuckite from Kaokoveld, Kunene region,  
Namibia. Photo: Bob Cooke.*



Diopside is a cyclosilicate, so when it crystallizes, its molecules are arranged in a ring structure. Of course, the structure is at the microscopic level and not visible to the eye.

At the macroscopic level, diopside forms crystals in the trigonal system; a common example of a diopside crystal is shown at left. However, the Goldschmidt Atlas of Crystal Forms shows 17 different forms in which diopside can grow.

Ground to powder, diopside can be used as an artistic pigment, and it has been used as such since Neolithic times. Neolithic statues with diopside as eyeliner have been found in Kazakhstan, so the mineral was mined and used there long before anyone knew what it was.

Due to its relative softness, diopside is not durable as a gemstone. It is sometimes used in wire-wrapped jewelry, with the raw crystallized specimen displaying its lovely color.

**Technical Details**

- Chemical formula .....  $Cu_6Si_6O_{18} \cdot 6H_2O$
- Crystal form..... Trigonal
- Hardness: ..... 5
- Density:..... 3.3–3.4



*Diopside with plancheite from the Mindoula District, Republic of Congo (Brazzaville). Photo: Bob Cooke.*



*Diopside from Kaokoveld, Namibia. Photo: Bob Cooke.*

- Color.....Green, usually deep green; usually, color is distinctive
- Streak.....Green
- Cleavage.....2 or 3 (sources vary!)
- Fracture .....Irregular
- Luster.....Adamantine, vitreous ↗

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## Erythrite

by Sue Marcus

Source: *The Mineral Newsletter*, June 2019.

Long ago, my mineralogy professor taught me that color should not be used to identify minerals. Don't believe everything you were taught—erythrite, June's Mineral of the Month, is an exception. Some references call it "crimson," but that shade is redder and hotter in my perception than erythrite. I'd agree with "magenta," the hue it was dubbed by another source.

The color, an identifying characteristic of this mineral, comes from cobalt. The only similarly colored mineral I am aware of is k ammererite, the chrome-bearing variety of clinocllore. K ammererite's morphology (crystal shape), luster, and localities make it easy to distinguish from erythrite. Sources report colors of erythrite ranging to pink, but these must be rare. I've only seen the lovely purplish hue.

Erythrite was named for its reddish color in 1832 by Fran ois Beaudant from the Greek  $\acute{\epsilon}\rho\upsilon\theta\rho\omicron\varsigma$  (*erythros*), the word for red. It is also called "red cobalt." Erythrite is part of the Vivianite Group, forming a solid solution series with annabergite, with nickel substituting for cobalt: erythrite is  $\text{Co}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$  while annabergite is  $\text{Ni}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$ .

Cobalt and nickel are different colorants, with cobalt associated with purple and nickel with green. In researching this article, I read that when the cobalt and nickel are about equivalent, the mineral is gray or off white—something I've yet to see.

I also learned more chemistry and mineralogy while investigating erythrite. Kottigite is similar to erythrite (isostructural in chemical terms), with zinc substituting for cobalt; unlike with annabergite, however, there is no series—there seem to be only end members. When magnesium or iron substitutes for cobalt, the



Erythrite from Bou Azzer, Morocco. Photo: Bob Cooke.

minerals are hornesite or parasymphesite, respectively. Again, there are no intermediate compounds; moreover, the ionic level of the chemistry is different, unlike with kottigite.

Erythrite occurs as a secondary mineral, forming from the oxidation of other minerals in sedimentary and metamorphic rocks. Erythrite is usually associated with quartz, calcite, limonite, and the ores of more collectible minerals such as cobaltite, skutterudite, scorodite, pharmacosiderite, adamite, and malachite. Other rare associated minerals are symplectite, morenosite, retgersite, and roselite-beta.

Although it can be a cobalt ore, erythrite is primarily a collector's mineral. And what attractive specimens they can be! Almost always, the erythrite crystals are in small groups of up to a few millimeters or centimeters on matrix. Well-formed crystals look like tiny asymmetrical swords. Numerous sources mention that erythrite crystals can be striated, although I see them as stacks of extremely thin (micaceous), parallel, laminar crystals. Crystals can also be fibrous or radiating acicular needles. None of these form large specimens. Coatings and earthy masses of erythrite are called "cobalt bloom."

The type specimens (originally described material) of erythrite came from the Daniel Mine (St. Daniel Mine) in the *Erzgebirge* (Ore Mountains) of Saxony, Germany. The type locality and its area, the Schneeberg District, produced small, classic sprays of crystals, including acicular sprays, although specimens are no longer found and are obtained only from old collections.



Erythrite from Bou Azzer, Morocco. Photo: Bob Cooke.



Formed from other cobalt minerals, erythrite is found in cobalt deposits and mines, such as at Cobalt, Ontario, Canada (associated with silver there) and at Mt. Cobalt, Queensland, Australia. Nice acicular sprays come from the Sara Alicia Mine, Sonora, Mexico.

Morocco is currently the main source of erythrite through the cobalt mines of the Bou Azzer District. The best and largest crystals come from Bou Azzer. The crystals are not acicular, but they are macroscopic—although there is something for everyone: micros are also available.

Erythrite can also be found in some nickel, copper, and other deposits where cobalt was not a major constituent, for instance in the tin mines of Cornwall, England, and the Dome Rock Copper Mine in South Australia. Chile, France, and the Czech Republic have also produced specimen material.

Erythrite occurs in the United States, though not in notable crystals. The classic U.S. localities, noted for other minerals, are French Creek in Chester County, PA, and the Blackbird District in Idaho. Both have produced crusts in the cobalt bloom form of erythrite.

Cobalt is used in the electrodes of rechargeable batteries and alloys, including the “superalloys” used for gas turbine engines. Cobalt is also used in vehicle airbags, as a petroleum catalyst, and in various other types of manufacturing. Morocco is the main producer of primary cobalt, although cobalt is also mined by small (artisanal) miners in Congo. Most of the world’s cobalt is produced as a byproduct of nickel mining. China is the world’s largest cobalt refiner and consumer of cobalt and the major supplier of refined cobalt used in the United States.

Erythrite specimens are delicate because they are soft—the crystals don’t break but do get crushed, so this is a mineral to enjoy carefully. Another reason to be careful is due to the cobalt and/or nickel and arsenic in this mineral. *No matter what minerals or rocks you are handling, wash your hands thoroughly afterwards.* Erythrite is less common and more expensive than some of the other minerals we’ve reviewed in this column, but it lends a bright spot of color to any collection. Put it next to a diopside specimen for eye-popping color contrast! ↗

### Technical Details

Chemical formula ..... $\text{Co}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$

Crystal form.....Monoclinic



*Erythrite from Bou Azzer, Morocco. (Specimen is 2.7 by 2.2 by 2.0 cm in size.) Source: Wikipedia; photo: Robert Lavinsky.*

- Hardness ..... 1.5–2.5
- Density ..... 3.06 g/cm<sup>3</sup> (measured); 3.12–3.13 g/cm<sup>3</sup> (calculated)
- Color..... Purple/violet-red, crimson, red, pink (according to references)
- Streak..... Pale red to pink
- Cleavage ..... One perfect
- Fracture ..... Sectile—that is, it may be cut but resists fracturing, bending, and then splintering
- Luster..... Waxy, vitreous, opalescent

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## Galena

by Sue Marcus

Galena is an interesting mineral that many people have collected. How could we have waited for years to devote an article to it? Let's see whether we can all learn something new.

Galena, the primary ore of lead, is a simple chemical compound, lead sulfide (PbS). It was originally named *galen* by Pliny the Elder in about 78 BCE (before the common era).

Common can still be attractive, as galena shows us. Fine cubic crystals occur from micromounts to monsters 10 inches long on a crystal edge.

A case near the entrance to the Gem and Mineral Hall in the Smithsonian's National Museum of Natural History has a spectacular pile of galena cubes. Many times, I've gazed at the specimen and wondered whether I could lift it—if I was even allowed to try, of course.

### Morphology

As with fluorite, the morphology (shapes) of galena crystals can modify each other: cubes can modify octahedrons; and octahedrons can modify cubes, dodecahedrons, and so on.

Although I don't know anyone who does, I suspect that some collectors specialize in collecting galena: you could assemble a beautiful, diverse, and educational collection from the different crystal habits and localities—and, given the weight, it would not be likely to be stolen.

Anglesite, cerussite, and other secondary lead minerals are formed from the chemical breakdown of galena. Traces of bismuth in galena's crystal structure (lattice) can encourage octahedral crystal growth; silver in the lattice can affect the way the specimen fractures, making it break in flaky or bent crumbs or pieces.

Argentiferous galena is the variety that is known to be silver bearing. Silver minerals can also form separate tiny grains in massive or even crystalline galena. The effects of the trace metals were something I learned about while reading about galena for this article.



**Top:** Galena on pyrite, Brushy Creek Mine, Oates, Viburnum Trend District, Reynolds County, Missouri. Source: Conroy (n.d.); photo: Kevin Conroy. **Bottom:** Galena, Petrovitsa deposit, Borieva Mine, Madan orefield, Rhodope Mountains, Smolyan Oblast, Bulgaria. Photo: Bob Cooke.

## Occurrence

In the United States, the largest galena deposits are in the Mississippi Valley, known as Mississippi Valley Type (or MVT) deposits. They include the Tri-State District of Kansas, Oklahoma, and Missouri; the Viburnum Trend District of Missouri; and other mining areas north to Wisconsin. The MVT features lead–zinc +/-copper (primarily as galena–sphalerite +/-chalcopryrite) deposits. The same type of deposits has now been identified on most continents.

These deposits formed at relatively low temperatures when mineralized waters intruded into calcareous sedimentary rocks (limestone or dolostone, a rock made up of dolomite). The upwelling fluids, saturated with metals, interacted with saline ground waters to precipitate fluorite and barite. The limestones contained natural joints and fractures that the fluids could penetrate. There is some evidence of preexisting caves and voids that became fluid traps.

The MVT deposits often formed in cherty limestones. The limestones dissolved, and the cherts that were left formed porous breccias amenable to the infusion of metal-bearing hydrothermal fluids. As the fluids reacted chemically with the preexisting rock, they evolved and cooled over time. The result was fractionation, with some minerals forming early and others later on.

Galena replaced the calcareous host rock in veins containing fluorite, barite, calcite, chalcopryrite, and sphalerite. Most veins are massive, although vugs (cavities) can be lined with stunning crystals in various combinations of minerals.

Other types of galena deposits, such as those in the Laisvall District in Sweden, formed under similar conditions but in clastic rocks like sandstone. The hydrothermal fluids can cause brecciation in both types of deposits, although replacement of the host rock occurs only in the MVT deposits.

Most galena deposits are strata bound, meaning that the upwelling fluids reached a nonreactive rock formation and spread out horizontally at the time of deposition. Later tectonic events could change the shape of the deposits, making exploration and mining more difficult. The tectonic events could cook the host rocks, turning them into skarn (a metamorphic rock).

Galena is common in metamorphosed volcanic deposits when existing rocks got caught in the processes that



*Galena, Brushy Creek Mine, Oates, Viburnum Trend District, Reynolds County, MO. Source: Conroy (n.d.); photo: Kevin Conroy.*

heated and squeezed the rocks. All galena deposits in Canada are hosted by metamorphic rocks; the crystals are gone but the galena is still there. Skarns are caused by hot intrusive rocks that punch up through limestones. Contact metamorphism replaces disseminated minerals, and the cooling that follows pulls the minerals back in and concentrates them into large masses. The intrusives are mainly in the granite family.

Galena is also found in geologic environments where an igneous intrusion (such as granite) caused the deposit's hydrothermal source fluids. I found passing mentions of galena in basalt and diabase, both mafic igneous rocks. However, I couldn't find any elaboration or confirmation of such unusual occurrences.

One source describes fibrous or platy galena, although such occurrences are highly unusual, at least in macro-specimens (specimens you can see, not micromounts).

I also came across a novelty—galena pseudomorphs after pyromorphite. Classic specimens from Germany's Kautenbach Mine are evidently rare, since the price I saw on one was \$15,000! To me, it looked like regular cubic galena. Other galena pseudomorph specimens come from Cornwall in England. Such specimens might well appeal to pseudomorph collectors—or to collectors who specialize in galena.

Is the “snow” or “frost” on Venus really galena? Some sources suggest that it might be. The material could

also be tellurobismuthite ( $\text{Bi}_2\text{Te}_3$ ) or coloradoite ( $\text{HgTe}$ ), although the most recent source I could find (from 2015) suggests that it is most likely to be a “ferroelectric material.” The earlier results (from 2013) were from low-resolution radar altimetry, whereas the more recent analyses relied on synthetic aperture radar and stereo radar elevation data.

### Early Uses

The word “plumbing” and the chemical symbol for lead ( $\text{Pb}$ ) both come from the Latin word for lead, *plumbium*, the material from which pipes were made. Because processing it is easy, galena might have been the first ore from which metal was extracted.

Lead from galena has been used since at least 6500 BCE, with the oldest artifacts being statues and beads found in what is now Turkey. Ancient Egyptians used lead-based cosmetics to protect their eyes from insects and the harsh sun. Egyptian pharaohs had lead pipes for plumbing. A lead glass recipe has been dated to 1700 BCE. In China, the Han Dynasty (206 BCE–220 CE) used lead in glass to mimic jade. The ancient Greeks and Romans recognized that galena could contain silver and devised effective separation processes to extract silver from the lead ore.

Since at least the 17th century, Native Americans—the Meskwakis (Fox) in what is now eastern Iowa and western Wisconsin—ground up galena for facial paint, much like the ancient Egyptians did. They kept the locations of the galena from the French and later English trappers and traders, instead trading chunks of galena to the Europeans. The Europeans processed the galena into lead shot that was traded back to the Meskwakis.

The Meskwakis grew to trust Julian Dubuque, a French-Canadian trapper who married a Meskwaki



*Galena cube on marcasite, Brushy Creek Mine, Oates, Viburnum Trend District, Reynolds County, MO. Source: Conroy (n.d.); photo: Kevin Conroy.*

## Galena Educational Puzzler

Here is an educational mindbender using galena.

Hold a small piece of galena in one hand and a large piece of pumice in the other. Ask someone (a noncollector) which is heavier. Most people will pick the larger chunk (the pumice), which is light due to the air it contains.

You can then talk about density (“heavy as lead”) compared to mass (the larger piece of pumice).



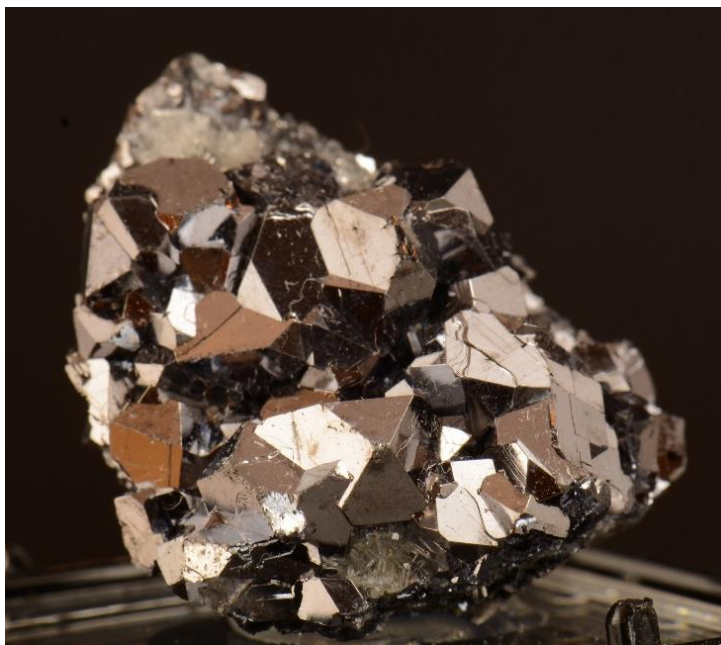
woman. They showed him their deposits and gave him control of their mines. The Meskawakis and Dubuque explored and worked lead deposits cooperatively until his death in 1810, when the lands were supposed to be returned to the natives.

Instead, the U.S. Army seized the lead deposits. A lead rush began in the early 1820s, although miners had to turn 10 percent of the lead ore they mined over to the Army. The rush ended when the miners dug deep enough to strike ground water; pumping out the water made mining unprofitable.

### Sources

MVT deposits in Missouri include the Viburnum Trend District, with the Brushy Creek Mine and the West Fork Mine. In the Tri-State District of Kansas, Oklahoma, and Missouri, galena replaced calcareous rocks to create deposits in localities such as Joplin, MO, and Picher, OK.

The last mine in the Tri-State District closed in Kansas in 1970 due to environmental and economic problems. In the 1960s, galena mining contaminated the air as well as ground and surface waters on ancestral lands of the Quapaw Tribe in Oklahoma. In northeastern Oklahoma’s Grand Lake o’ the Cherokees, fish advisories continue to this day. The Tar Creek Superfund Site was declared in the same area in 1983.



*Galena, Petrovitsa deposit, 9th of September Mine, Madan orefield, Rhodope Mountains, Smolyan Oblast, Bulgaria.  
Photo: Bob Cooke.*

Galena is the state mineral of Kansas, Missouri, and Wisconsin. Towns in Kansas and Illinois bear the name Galena for lead ore mined there. Wisconsin earned its nickname as the Badger State because miners in the 1820s were prospecting for galena in the southwestern part of the state. They didn't take time to build houses, instead burrowing into hillsides or living in mine tunnels, dwelling underground like badgers. The miners were sometimes called "badger boys," and the nickname spread to the whole state.

Some of us have had the pleasure of visiting Leadville, CO, which was established after galena was discovered nearby. Other famous Colorado mining districts like Ouray and Central City also produced galena as well as specimens for collectors. Silverton got its name from the highly argentiferous galena mined nearby.

More unusual U.S. localities for galena include Wurtzboro, NY, and Shullsburg, WI. Idaho's Coeur d'Alene Mining District was rich in silver, much of which came from galena, although other silver-bearing minerals were found there too.

In 2018, five Missouri mines still produced lead, along with a total of five mines in Alaska, Idaho, and Washington. Along with newly mined ore, recycling of batteries and other lead products is an important source of lead in the United States.

Peru has been an abundant source of galena in wonderful, diverse crystal forms, often together with other metallic minerals. Galena comes from mines in the Huarochiri, Huancavelica, and Pasco areas of Peru, among others. The specimens are usually untarnished, brilliant pieces. Peruvian specimens can be found in prices fitting any collector's budget.

Mexico produces galena crystals from Naica and Mapimi. China is the world's largest lead producer (at about 2,100 metric tonnes per year), with Australia in second place, though far behind (at about 450 tonnes).

In Weardale and Alston Moor, England, galena and fluorite form classic, beautiful specimens. The largest known galena crystal, 10 inches on each edge, comes from England's Isle of Man, not a noted collecting locality.

From continental Europe, notable galena occurrences come from the Black Forest, the Harz Mountains, and Siegerland in Germany. Trepca in Serbia and the Maramures region of Romania also feature galena mines.

*Collectors beware:* skeletal galena that seems to be etched might have been intentionally altered by unscrupulous sellers. Galena crystals from the Rhodope Mountains, Madan, Bulgaria seem to be the ones most frequently altered, particularly those from the 9th of September Mine (see, for example, Haynes 2009).

### **Processing Galena**

Galena is often found with copper minerals (chalcopyrite, tennantite, and tetrahedrite), zinc minerals (sphalerite and hydrozincite), and secondary lead minerals like cerussite, along with "gangue" (noneconomic) minerals like calcite. In certain geologic environments, galena deposits may contain up to 20 percent silver, making them a valuable silver ore.

### **Collector's Tip**

The Minerals.net website offers a collector's tip for improving the looks of tarnished galena specimens: using water and mild soap. However, galena specimens can be brittle or have begun to corrode, so they should be handled with care. Another source indicates that hot water can crack specimens (due to expansion and contraction during heating and cooling), so wash gently.

Pyrite can pose a processing problem, but if it contains sufficient gold, the value of the gold and the value of the silver contained in the galena can cover the mining costs, leaving lead, copper, and zinc products as profits. Deposits composed mostly of galena, chalcopyrite, and sphalerite (like the specimen shown on the right) can be economically viable if there is enough silver in the galena and enough gold in the pyrite.

However, the arsenopyrite found in some deposits poses severe processing problems. The market for arsenic is not as large as the markets for precious metals and for base metals other than lead. Moreover, the disposal of arsenic is difficult because it is a toxin.

### Uses of Lead Today

Batteries, including vehicle batteries, are the leading use of lead in the United States. Lead is also used in bullets and fishing sinkers. Lead is used as a shield from radiation in television and other screens or when we have medical x-rays or other diagnostic tests like CAT scans: the apron draped over you by the technician contains lead. Lead liners also seal radioactive chambers.

Was galena used in “lead” pencils, which are now made of wood, clay, and graphite? Sources differ. Some say never, others say it happened long ago.

In the United States, lead from galena was used in early electronic devices. Throughout history, lead has been used as a glaze for pottery, and lead was formerly



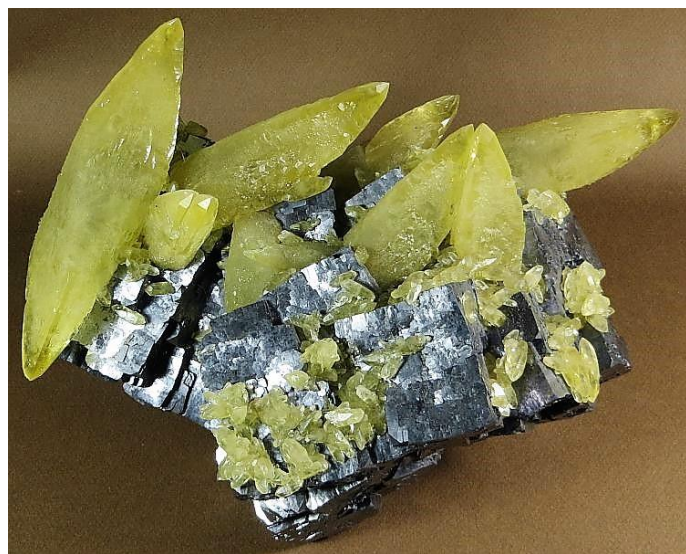
*Galena with chalcopyrite, sphalerite, and other minerals, Primorskiy Kray, Russia. Source: Smithsonian Museum; photo: Chip Clark.*

used in paints to make the coating opaque and durable and to accelerate drying. Since antiquity, lead has also been used in plumbing. Older buildings and water systems still contain lead.

Such uses have long since ceased because lead in the environment is toxic to humans and many other living organisms. In children, excessive lead absorption affects brain development.

The Clean Air Act of 1970 was, in part, a response to the inadvertent discovery of lead pollution in the environment. A scientist was trying to calculate the age of the Earth using a process that required pure natural environments, including lead-free air. She couldn't find any because lead mining in the United States had spread lead into the atmosphere across the nation. Lead mines, especially in the central United States, have left environmental legacies that include pollution from waste dumps, radon, and other toxins like lead in dust.

Accordingly, some states now have buyback programs for potential lead pollutants such as bullets and fishing sinkers. Lead is no longer used to solder food cans (although solder from metals other than lead can create its own problems). In the United States, gasoline no longer contains lead. Pewter, an alloy of tin and other metals, used to contain lead, possibly at toxic levels, although modern pewter that might come into contact with food rarely contains lead.



*Calcite and galena, West Fork Mine, Centerville, Viburnum Trend District, Reynolds County, MO. Source: Conroy (n.d.); photo: Kevin Conroy.*

Another previous use of lead was to make “crystal” for high-quality and high-priced glassware (for example Waterford Crystal) or chandeliers. Leaded glass is heavy and refracts light so that it sparkles brightly. Lightly striking the rim of a leaded wine glass causes a unique ring. The brilliance (refractivity) and tone (sound) of leaded glass are directly due to the lead. ↗

### Technical Details

Chemical formula .....PbS  
 Crystal form.....Isometric  
 Hardness .....2.5  
 Density.....7.4–7.6  
 Color .....Gray, silvery when fresh;  
 dark gray sometimes, with white to orange al-  
 teration crusts  
 Cleavage .....Three perfect, at 90° angles  
 Fracture.....Brittle, subconchoidal  
 Luster.....Metallic when fresh or not  
 tarnished; dull and darker when tarnished  
 (with further color change if chemical altera-  
 tion is occurring or has occurred)  
 Streak.....Gray-black

### Acknowledgments

I would like to thank my husband, Roger Haskins, for his helpful review and additions and Hutch Brown for his skillful editing.

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## Hematite

by Sue Marcus

October's Mineral of the Month is hematite, a major ore of iron that comes in diverse morphologies. Let's explore it together.

### Ancient Uses and Etymology

Hematite has been used since prehistoric times. Think of the red "paint" used in cave drawings. That was ocher, a powdered material containing 20- to 70-percent hematite. A Wikipedia article states that ocher was used 164,000 years ago "for social purposes."

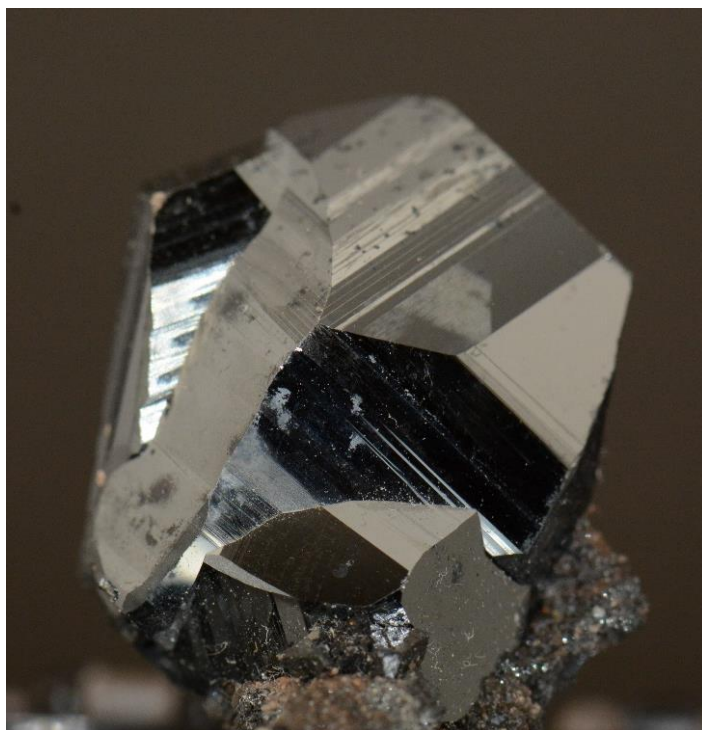
Hematite was mined on the Mediterranean island of Elba by the Etruscans, so this mineral has a long history of use. That is reflected in the evolution of its name, which derived from the red types of this mineral. Mindat credits Theophrastus with its first name in 300–325 BCE, αἱματίτης λίθος which translates to *haimatitēs lithos* or "bloodstone." Then sources differ, with Mindat giving Pliny the Elder credit for translating the name in 70 CE to *haematites* ("bloodlike"), thus giving this mineral name the distinction of being the first with -ite as its suffix.

Other sources conclude that, in the 15th century, the original ancient Greek became Latin *lapis haematites*, which was revised to Middle French *hématite pierre* ("bloodstone"). Some European sources may still prefer spelling it haematite.

There will not be a quiz on all this!



*Kidney ore hematite, a reddish form of the mineral, from Cumberland, England. Photo: Bob Cooke.*



*Hematite from the Black Rock Mine, South Africa.  
Photo: Bob Cooke.*

### Forms

The reddish streak of hematite is a good indicator, and its lack of magnetism is also a useful clue. Remember that hematite can become magnetic upon heating or if the material is intermingled with magnetite.

The red nonmetallic types of hematite can be used as pigments and are softer and easier to work than the more interesting collectible types of hematite, which are black and metallic to submetallic. There are mammillary or botryoidal masses that form interesting shapes, including stalactites and stalagmites and beautiful rosettes of lustrous metallic crystals.

The rosettes are the most highly prized by collectors. Add one or more sparkling, contrasting tiny quartz crystals and you have a stunning specimen. Of special interest to collectors who specialize in pseudomorphs (minerals replacing other minerals or materials) are hematite pseudomorphs after magnetite. "Kidney ore" is a term for lumpy botryoidal masses of hematite.

### Banded Iron Formation

The relatively simple chemistry of hematite ( $\text{Fe}_2\text{O}_3$ ) and the significance of oxygen in the formula help us



understand that hematite usually forms in low-temper-



*Botryoidal hematite from the Red Mountain Mine, Augusta County, VA. Photo: Bob Cooke.*

ature environments with water present. Hematite forms in all three major rock types.

Banded iron formation is the sedimentary and most economically important form of hematite. These formations were laid down billions of years ago. Fine-grained massive hematite with magnetite comprises the dark bands and stains the silica-rich red bands.

Most U.S. iron production is in the banded iron formation in the Iron Range of Minnesota and, to a lesser extent, in Michigan. There is (or was) a huge hunk of banded iron formation outside the south entrance of the Smithsonian's Natural History Museum.

Hematite in banded iron formation is the production source for most of the ore extracted at the Carajás Mine in Brazil, the world's largest iron mine, with deforestation as a significant byproduct. Weathered iron-rich material above the unweathered hematite is the easiest ore to mine. The site is so large that it can readily be identified from satellite images.

### **Igneous and Metamorphic Sources**

In igneous rocks, hematite can be found in granites or as a hot-springs precipitate (volcano-sedimentary?) in places like Yellowstone. Granites host vugs favoring formations of the rosettes coveted by collectors. Granitic iron deposits are smaller than the sedimentary banded iron formations, but they were more easily identified and worked in antiquity.

What about hematite in metamorphic rocks? Well, the banded iron formation is metamorphosed from sedimentary rocks, so it can count for both rock types.



*Hematite rose on quartz from the Massif du St. Gotthard, Switzerland. Photo: Bob Cooke.*

Hematite can also form during contact metamorphism, when magma or tectonism cooks other rocks.

Wait—there's a uniquely rockhound twist to the metamorphic-hematite part of this story. Iridescent hematite occurs naturally in Brazil (and therefore probably elsewhere in the world) in metamorphic rocks. See the section below on uses of hematite for jewelry for more information.

Oolitic iron ore is another economically important form of hematitic iron. "Oolite" means a rounded or egg-shaped object, usually with concentric rings. It forms when hematite chemically precipitates (the conditions are not understood).

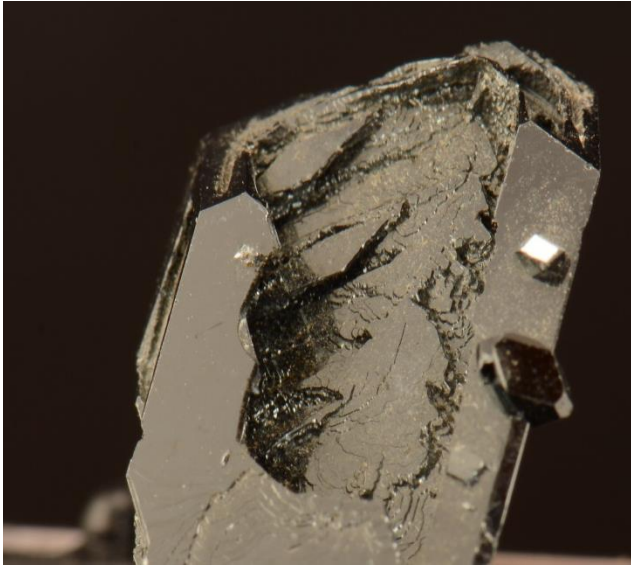
### **Collecting**

Because hematite is relatively common, collectors can visit many noted specimen localities. With the diversity of forms, you could end up with a collection of hematite-specific specimens and a fine assemblage to show.

Elba, Italy, is a classic source, as are the Swiss Alps. Both have produced iron ore and hematite crystals for as long as there have been collectors. But specimens are also readily available on the market.

Specularite is a micaceous form of hematite, usually not as interesting to collectors. But if you want English specimens, you might find this type of hematite from Cumbria (in northwestern England).

Brazil is another producer of hematite specimens, including some rosettes. China is now a powerhouse for lovely and lustrous rosettes. These are the prettiest I've seen.



*Hematite from Ures, Sonoma, Mexico.  
Photo: Bob Cooke.*

Morocco has produced various forms of hematite—mammillary; single crystals; and odd, flattened “skel-etal” crystals from numerous localities. The flattened crystals from Nador are an interesting addition to any collection. South Africa’s Wessels Mine has produced stunning hematite crystal groups and even more beautiful individual silver-black hematite crystals with deep red andradite (garnet) overgrowths. Moroccan mines and the Wessels Mine are still producing, so we hope for new discoveries.

Hematite is found in many U.S. localities, although attractive specimens are not abundant or well known. Perhaps the best U.S. specimens came from Chubb Lake in St. Lawrence County, NY, in the late 1990s. Like many other showy hematites, these are submetallic and associated with quartz.

### Uses

Hematite is mined for iron, which is used for steel production. Australia is the world’s largest iron producer. Iron (hematite) mining on Elba began by the 8th century BCE, when the Etruscans operated furnaces 24 hours a day. Mining on Elba only ceased in 1980, and some areas are now a historic mining district.

Powdered hematite is used as a polishing compound known as jeweler’s rouge and an additive to brass and silver polishes. Look at the ingredients in solid makeup. If iron oxide is listed, it might be hematite, adding a reddish hue.

Naturally occurring iridescent hematite, also called rainbow hematite, came from the Andrade Mine in Minas Gerais, Brazil, in the 1990s. This brittle, splintery material is of little interest to mineral collectors but a boon to jewelry designers—and buyers. The iridescence comes from nanoscale replacements and alignments, with gorgeous results. This shows hematite in ways most of us never expect from plain old iron oxide.

Harking back to the origin of hematite’s name, some rockhounds are familiar with bloodstone, an agate-like form of quartz with green “moss” and red bloodlike specks. The red is caused by hematite.

Lustrous silvery-black hematite, notably from Brazil, is used in jewelry and carving. Buyer beware! Many novelty items that are labeled “hematite,” if magnetic, are synthetic composites of ground hematite and magnetite.

Hematite has even been detected on Mars! Not as the red in the Red Planet but as “blueberries” (see the photo below). These are rounded hematite concretions that are believed to have been formed with water.

### Technical Details:

- Chemical formula... $\text{Fe}_2\text{O}_3$
- Crystal form .....Hexagonal/Trigonal
- Hardness .....5–6.5 (sources vary)
- Specific gravity .....5.3
- Color.....Metallic black to gray, nonmetallic red



*Iridescent hematite from Elba, Italy.  
Source: Ma and Rossman (n.d.).*

Streak..... Brick red  
Cleavage ..... None, though may show parting  
Fracture..... Uneven to subconchoidal  
Luster..... Metallic, reflective black

### Acknowledgments

I would like to acknowledge the helpful review and additions by my husband, Roger Haskins, and supreme editor Hutch Brown for his skillful editing.

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*Hematite "blueberries" on Mars. Source: NASA, Wikipedia.*

## Malachite

by Sue Marcus

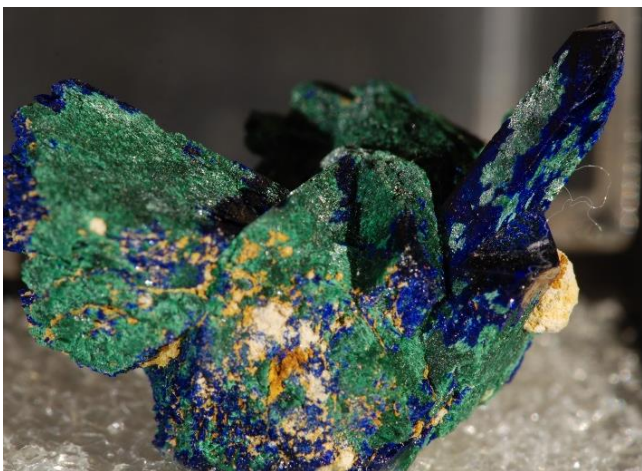
Source: *The Mineral Newsletter*, March 2019.

**M**alachite green: a color. Malachite jewelry. Malachite as *objets d'art*, or a room of them, as in the Hermitage in St. Petersburg, Russia. For those of us who treasure it as a collectible mineral, malachite is colorful and accessible, and it can be affordable. Collectors can also spend sky-high amounts for specimens, too. Many of us have had the fun of collecting malachite ourselves.

I can't say that malachite is as old as dirt, though it may be. The name, based on the color of the mallow plant's leaves, was reported by Pliny the Elder in 79 CE (AD). Our current spelling has been used since at least 1661.

Malachite has been mined for copper and other uses since prehistoric times. The earliest known copper mining, by Egyptians in what is now Israel's Timna Valley, led to the construction of the Temple of Hathor, the goddess of many things, including protecting miners. These mines were probably active during the reigns of the biblical kings Solomon and David and may be part of the former's famous mines. There were Neolithic malachite mines in Britain.

Malachite is usually hosted by limestone deposits. It is usually a secondary mineral, occurring when primary copper minerals are attacked by water and air or by fluids not far beneath the surface of copper-rich deposits. Azurite is particularly susceptible to alteration into malachite. These two colorful copper minerals make stunning specimens, especially when there are large azurite crystals altering to malachite. Such specimens



Malachite on azurite from Bous Kour, Morocco. Photo: Bob Cooke.

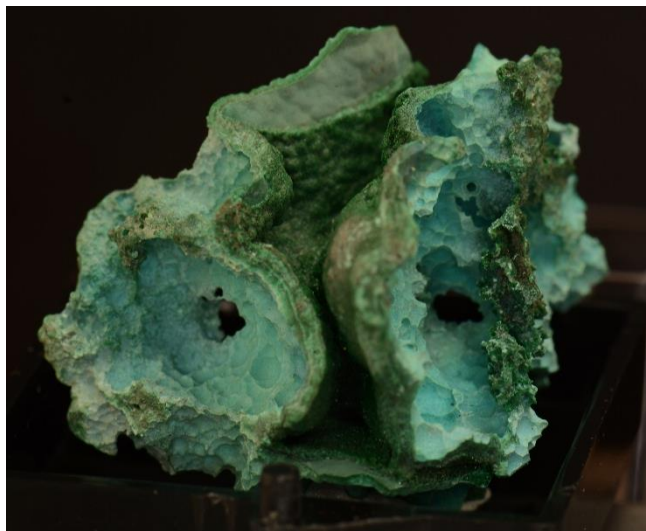


Malachite from Kerrouchen, Morocco. Photo: Bob Cooke.

are usually priced according to their visual appeal and scarcity—that is, highly priced! This is also true for specimens of pseudomorphs of malachite after azurite, when well-crystallized azurite has been completely replaced by malachite.

Major current sources of malachite specimens include the Democratic Republic of Congo (DRC), formerly known as Zaire, the location shown on many older labels. Specimens from the DRC are often botryoidal and may form stalactites or stalagmites many inches long, a relatively rare shape in the mineral kingdom. Rather confusingly, the Republic of Congo (Brazzaville) also produces fibrous malachite specimens, though not on the scale of the DRC. Tsumeb, Namibia, has produced stunning azurite crystals; the locality is famous for (among other things) malachite pseudomorphs after azurite. Malachite is also found in Tsumeb as smaller primary crystals, acicular coatings, masses, and balls. Namibia's Emke Mine is another producer of beautiful specimens.

In the past few years, the Milpillas Mine in Sonora, Mexico, has produced beautiful azurite crystals and fewer malachite specimens. From the photos for this locality on Mindat, the malachite specimens shown rival the ones from Tsumeb. Previously, Mexico had



*Malachite with chrysocolla, Mashamba West Mine, Kolwezi District, Katanga, Democratic Republic of Congo. Photo: Bob Cooke.*



*Malachite pseudomorph after azurite, New Cornelia Mine, Ajo, Pima County, AZ. Photo: Bob Cooke.*

been a source of mostly lower quality malachite specimens from a wealth of copper deposits.

Malachite pseudomorphs after cuprite are another attractive type of pseudomorph specimens. These are best known for the classic old, aptly named Chessy-les-Mines locality near Lyon, France. The mines closed more than a century ago, so specimens are scarce. Malachite pseudomorphs after cuprite have also come from other sites, though infrequently.

Morocco's azurite is better known to collectors than its malachite, although where there's azurite, there's usually malachite. The Moroccan material comes in many forms but is not as spectacular as pieces from other localities.

Oddly, I could find no notable malachite localities in Chile, which is known for copper production. This may be due to the younger age of the Chilean deposits and a dry climate that did not provide the necessary oxidizing conditions.

Rum Jungle and the Burra mines are among the best known of the Australian localities. These mostly produced botryoidal malachite, although rare crystals or pseudomorphs after azurite are also reported. Brazil, China, and many other countries have produced collectible specimens of malachite, though not to the extent of the localities noted previously.

The United States has malachite in many places. Former copper mines in Arizona produced the most stellar

U.S. specimens. The best of these include malachite pseudomorphs after azurite, with pseudocrystals of 3-plus centimeters in size, large botryoidal masses, and lovely fibrous coatings of fine crystals. Bisbee is the most famous of the Arizona localities, although Morenci and other mines also produced specimens. We can even find malachite in Virginia. Local specimens aren't spectacular, yet Mindat shows six specimens from Virginia, including one from Vulcan Quarry in Manassas that was collected and photographed by Robert Simonoff.

In the 18th and 19th centuries, Russian mines in the Ural Mountains provided the czars with copper and with massive malachite for lovely works of art. In the 1830s, more than 70 tons of massive malachite were produced for such uses. Russian artisans developed unparalleled skills in piecing together small bits of malachite to form large objects that appear seamless, as if the malachite was curved from a solid, unbroken mass. Another awe-inspiring use of malachite is the Malachite Room in the Castillo de Chapultepec in Mexico City, which features huge doors of malachite. Grand palaces in other parts of the world are also decorated with large malachite items.

Other copper minerals are richer in the metal, although malachite can be mined for copper. Most specimen localities are or were copper mines, although malachite is not the main mineral of mining interest. The main uses of copper in the United States are in construction (for copper pipes and so on), for electrical purposes, and in transportation. Copper also goes into brass and

bronze alloys. Although the United States produces copper from about 20 mines, we also import copper ore from Chile, Canada, and other countries. Our country is also a copper exporter.

Readily available, easy to work, and known for centuries, malachite was used by ancient people in both Egypt and Central and South America in their death rituals and funerary objects. The ancient Egyptians even referred to the afterlife as a “Field of Malachite.” Malachite is soft and easily ground to powder, so pigments were used by ancient Egyptians in tomb paintings. Using malachite pigments for painting continued into the 17th century in Europe. Malachite is still sold as a pigment for historical restorations. By the way, malachite green (the color) is named for malachite, even though the pigment of that name does not contain the mineral or even copper!

The mineral has long been used in jewelry. Mixtures of malachite and other copper minerals make lovely stones for jewelry due to the color contrasts of greens and blues (azurite, turquoise, and so on). Translucent malachite crystals are too small to be cut as gemstones, and all other malachite is opaque, so all malachite jewelry is opaque. Malachite is fairly soft, so it is not a stone that will take abrasion or hard use in jewelry.

Modern lapidaries have been informed by modern chemists and others who recognized that malachite dust can be toxic. If you make cabochons or do other lapidary work with malachite, check on what precautions should be used.

Pseudomalachite is a completely different phosphate mineral ( $\text{Cu}_5(\text{PO}_4)_2(\text{OH})_4$ ) usually occurring as very dark green botryoidal crusts. It is not malachite—just pseudo.

### Technical Details

Chemical formula .....	$\text{Cu}_2\text{CO}_3(\text{OH})_2$
Crystal form.....	Monoclinic
Hardness .....	3.5-4
Specific Gravity .....	3.6-4
Color .....	Green, sometimes banded with very dark green
Streak.....	Green (light)
Cleavage .....	One perfect; one fair
Fracture.....	Uneven to subconchoidal
Luster.....	Vitreous in single crystals; silky when fibrous ↗



Malachite from Tsumeb Mine, Tsumeb, Oshikoto Region, Namibia. Source: Mindat; photo—Manfred Kampf.

### Acknowledgments

I would like to acknowledge the helpful review and additions by my husband, Roger Haskins, and supreme editor Hutch Brown for his skillful editing.

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## Muscovite

by Sue Marcus

Once again, we choose a mineral of the month that most of us might have in our collections, common yet interesting. From my perspective, I figured it would be easy. And once again, I am learning more about minerals.

### Mica Sheets

Muscovite, our June 2018 Mineral of the Month, is indeed common and interesting, even though it is a complex phyllosilicate. That means that there are many elements along with silicon in the chemical formula, and the structure of the mineral occurs as thin sheets stacked upon each other. The sheets, which are characteristic of all micas and some other minerals like chlorite, form from rings of molecules that lock together.

The mica group, of which muscovite is a part, is typified by brittle single sheets that form durable, tough “books,” as the stacked sheets are called. Individual sheets of muscovite may be flexed gently and are usually completely transparent. Muscovite crystals are thicker and usually translucent to opaque, like the specimen at upper right. So the crystals are usually opaque in all dimensions unless they are separated into thinner sheets.

### Name

What do a type of duck, a mineral, and a Russian province have in common? A name—based on the medieval Principality of Muscovy—and, for our purposes, the mineral muscovite.

The mineral was originally used as window coverings, perhaps not totally transparent but translucent enough to transmit light and still protect those inside from the weather. The name apparently predates the 1794 usage by the German mineralogist Johann Gottfried Schmeisser. According to sources, muscovite has also been called cat’s silver and stone mirror, though I’ve never heard those terms; they may be either obsolete or used in other countries. Isinglass and glimmer have been used for muscovite but also for other minerals.

### Formation

Muscovite occurs in all three major rock types. The largest crystals, up to 5 by 3 meters in size (reported



*Muscovite with beryl, from Paprok, Afghanistan.  
Source: Wikipedia; photo: Rob Lavinsky.*



*Muscovite window from Russia.  
Source: Wikipedia.*

from Nellore, India), are found in pegmatites. The relatively slow crystallization of the magma into rock allowed the mica and other mineral crystals to grow as the layers of molecules built up.

Mica, whether muscovite, biotite, or another member of the mica group, is an integral component of granite, pegmatite's smaller grained cousin. The breakdown of feldspar, mica, and other minerals leads to mica in sedimentary rocks. Muscovite is also common in metamorphic rocks like schists and gneisses. Heat and pressure change clay into mica and the surrounding minerals.

Muscovite is usually an attractive costar in most mineral specimens, with a beryl (such as aquamarine or emerald) grabbing the limelight, like in the specimen on the first page. We should all have a lovely muscovite crystal or a group of them in our collections.

### Sources

Look at the beautiful star muscovite crystals from localities like Minas Gerais, Brazil. These are delicate because the edges flex and therefore deform. Still, as with many other delicate minerals, a nice specimen is worth having. Brazil is the major producer of nice muscovite specimens, although South Dakota is another good source, as is (more rarely) New England.

Erongo, Namibia, may be better known for producing aquamarine, although small yellow rosettes of muscovite crystals are pretty, too—and probably not as expensive. Muscovite pseudomorphs after tourmaline are reported by Minerals.net from Pinal County, AZ.



*Muscovite from Minas Gerais, Brazil.  
Source: Mindat; photo: Rob Lavinsky.*

Gemmy green crystals are reported from North Carolina by the same source, although I could find no confirmation. Wherever there are pegmatites, muscovite crystals are possible.

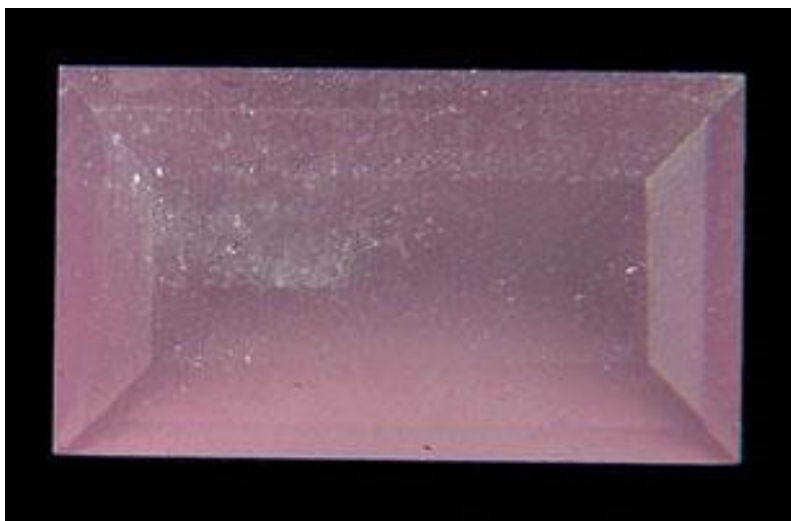
For eye-catching photos, as usual, see the Mindat reference below. Mindat lists varieties of muscovite from A to Z, literally—although some of these appear to have only tangential links to muscovite. The only ones with which I am familiar are sericite, simply a fine-grained variety, and fuchsite. Fuchsite is a green variety of muscovite, with chromium replacing some of the aluminum in the crystal structure.

Why aren't fuchsite or other varieties a separate species? I don't know.

### Uses

Muscovite may be attractive, but it is not a gemstone. It is almost always too brittle to cut, but experience has taught me to check my assumptions. I had assumed that muscovite was never faceted until I found that the Gemdat website showed a pink faceted (left) and a dark cabbed muscovite.

Muscovite is a common mineral; the portrayal of only two cut stones by Gemdat indicates how unusual it is as a lapidary material. I suppose muscovite could be used for a unique wire-wrapped piece.



*Faceted muscovite from Brazil, 1.94 carats.  
Source: Gemdat.*



Muscovite has numerous uses because it is water resistant, light, inert, an electrical insulator, heat resistant, and reflective. It is also relatively common; therefore, because it is also lightweight, it is inexpensive to transport. Georgia, North Carolina, and South Dakota, along with foreign sources, have produced “scrap mica,” small flakes that are used for joint compound, paint, oilwell-drilling materials, and possibly cosmetics.

Large muscovite sheets are imported, primarily from India, although North Carolina (the Spruce Pine area) has produced small amounts. Sheet mica is mostly used for electrical applications.

Muscovite provides the sparkle in kids’ toothpaste and in many cosmetics. Muscovite was used for the window in wood or coal stoves due to its heat-resistance.

Some of our older readers may remember formica. It was a synthetic product used for countertops and other purposes where a durable, heat-resistant surface was desired. The name comes from “formulated mica.” When the synthetic material was invented in 1912, the manufacturer used it in electrical insulation as a substitute for mica. Uses subsequently expanded to include kitchen counters. ↗

### Technical Details

- Chemical formula ..... $KAl_2(AlSi_3O_{10})(OH)_2$
- Crystal form.....Monoclinic (pseudo-hexagonal)
- Hardness .....2.5–2.8 (sources vary)
- Density.....2.7–3 (sources vary)
- Color.....Clear, white, yellow, silvery
- Streak.....White
- Cleavage .....One perfect cleavage
- Fracture.....Uneven
- Luster.....Vitreous, pearly

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*Hand carved from mica, Hopewell Culture (100 BC–500 AD), Hopewell Mound Group, Ross County, OH. Source: National Park Service.*

## Olivine

by Sue Marcus

Source: *The Mineral Newsletter*, April 2018.

Olivine appeared to be an interesting mineral—attractive, available, even collectible—so it was chosen as our Mineral of the Month for April. For those who have followed articles on the Mineral of the Month, we have learned about mineral “series”—that is, minerals with chemical formulas that grade into one another, forming a sort of chemical spectrum as one or more elements substitutes for another. Olivine is one of those.

Olivine used to be a simple, singular mineral. “When I was in school ...” Now, most people consider olivine to be the umbrella term for the solid solution series of magnesium-rich forsterite ( $\text{Mg}_2\text{SiO}_4$ ) to iron-rich fayalite ( $\text{Fe}_2\text{SiO}_4$ ). Less common minerals in the olivine group—or less commonly identified with them—include kirschsteinite ( $\text{CaFeSiO}_4$ ), monticellite ( $\text{CaMgSiO}_4$ ), and tephroite ( $\text{Mn}_2\text{SiO}_4$ ).

With its yellow-green color, it is easy to see that olivine acquired its name from the green olive fruit. Because the chemistry can vary throughout the olivine group, the origin of specific names has come and gone with the individuals who described their material in hand. I will leave you with the knowledge that you will soon be reading about the ancient mining of these materials and that we’ll ignore the names that became mineralogical ephemera.

Olivine occurs in all three major rock types. Olivinite and peridotite are names for igneous rocks predominantly containing olivine. Scientists believe that most of the upper mantle is composed of olivinite (that is, olivine plus a few silica-poor minerals). Olivine can be scientifically important in determining the geological origins of the rocks that contain it.

Rocks in Hawaii and other volcanic regions host phenocrysts of olivine: the olivine formed early in the process of magma solidification, then the olivine chunks were caught up in the still-fluid magma as it came to the surface. Olivine is found in metamorphic rocks derived from these igneous rocks. Olivine also forms sand and even beaches when weathered from relatively young volcanic rocks in places like Hawaii.

I always learn something when researching these articles. Olivine is used for sequestering carbon dioxide!



*Olivine from the Kohistan District, Pakistan.*  
Source: Wikipedia; photo: Rob Lavinsky.

At the other extreme, it is used in Finland in saunas. More mundanely, olivine has uses in steel manufacturing, including as a flux, and it is used in molds in aluminum foundries.

Peridot, sometimes called chrysolite, is yellow-green and is the gem form of olivine and the August birthstone. Peridot is a name of unknown origin, although



*Forsterite.* Photo: Bob Cooke.



*Forsterite. Photo: Bob Cooke.*

many possibilities have been suggested. It seems to have started as a term used by merchants and jewelers in the 1300s rather than by those exploring natural sciences.

A well-known U.S. locality, near Peridot, AZ, is on the San Carlos Indian Reservation. Most peridot is fine grained, fractured, untransparent, and therefore unsuitable for cutting. Larger pieces are usually faceted unto semiprecious stones.

The Egyptian locality of Zabargad Island, in the Red Sea, is the source of the best faceting material. Mindat reports that there is no evidence of mining before 2500 BC on Zabargad! The mines were mentioned by Pliny the Elder in 79 AD. A 20-centimeter crystal was found there. It was also the source of the largest faceted peridot, a 311.8-carat gem residing in the Smithsonian Institution's National Museum of Natural History (shown below). Mogok, Burma (Myanmar), and the gem-rich pegmatites of Pakistan are other sources of beautiful peridot crystals for collections or for cutting.



*Peridots and peridot necklace. The gem sources range from Egypt, to Myanmar, to Pakistan, to Norway, to Arizona, to Antarctica. Source: Smithsonian Gem Gallery; photo: Chip Clark.*

The Smithsonian even has a 3.07-carat faceted peridot from Antarctica.

Extra! Extraterrestrial! This month, we have a mineral that has been found in sources from places other than Earth. Olivine has been reported from meteorites and asteroids as well as in rocks from the moon and Mars.

λ.

### Technical Details

Chemical formula .....  $(\text{Mg}^{2+}, \text{Fe}^{2+})_2\text{SiO}_4$  (Wikipedia)

Crystal form..... Orthorhombic

Hardness ..... 6.5–7

Density..... 3.2–3.37

Color ..... Usually shades of green, from yellowish-green though olive to yellowish-brown

*Forsterite*: colorless (pure, rare); uncommonly white, gray, or orange, along with greens and browns

*Fayalite*: brown, yellow-brown

Streak ..... Colorless, white

Cleavage ..... Two good cleavages

Fracture..... Conchoidal

Luster..... Vitreous

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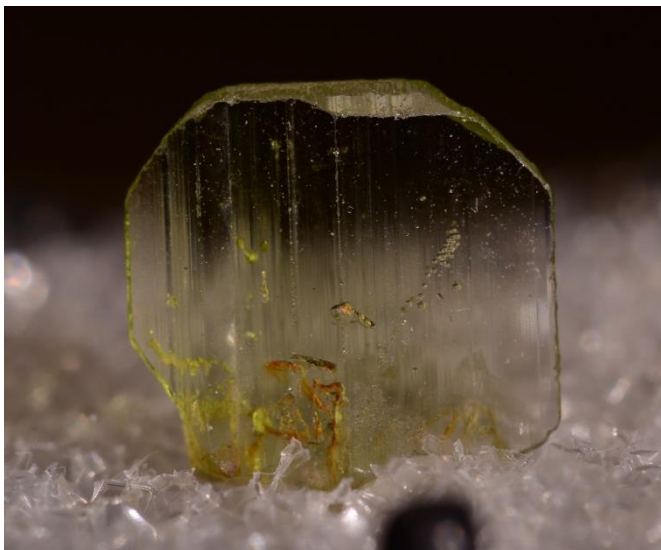
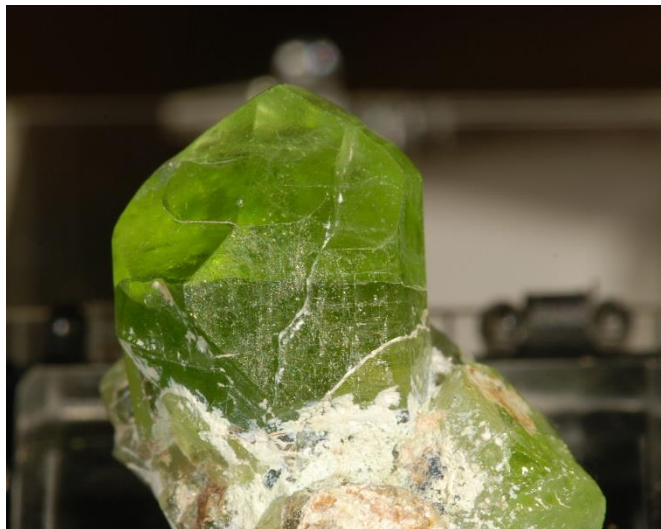
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*Forsterite samples. Photos: Bob Cooke.*

## Pyromorphite

by Sue Marcus

Source: *The Mineral Newsletter*, February 2018.

This month, we are learning together about the mineral pyromorphite.

### Name Origin

One of the first things I learned is to be grateful for the name. This lead mineral has been known since at least the mid-1700s, when it was called *Grön Blyspat* (Swedish), *Minera plumbi viridis* (Latin), and *Mine de plumb verte* (French). I assume the latter two are roughly translated as “green lead mineral.”

*Grön Blyspat* was the name used by the Swedish chemist Johan Gottschalk Wallerius (1709–1785). The cognate in German would be *Grünbleispat* or *grüner Bleispat*, meaning green lead spar. Pyromorphite was also known as *Grünbleierz* (green lead ore), *Braunbleierz* (brown lead ore), *Traubenblei* (grape lead, no doubt for a botryoidal form), polysphaerite, nuissierite, miesite, cherokee, collicite, plumbeine, and finally (true!) sexagulit.

Why so many different names? Probably because this mineral is unusual (though not rare) and often colorful (though in different colors or shades), so people thought they had specimens of different chemical compositions and therefore different minerals.

The name pyromorphite, bestowed in 1813 by the German mineralogist Johann Friedrich Ludwig Hausmann (1782–1859), makes sense when we tease out its meaning. *Pyro* means fire in Greek, and *morpho* is shape. When melted by heat (fire), the goo will begin to recrystallize as it cools, taking shape, as it were, from the fires of melting.

### Characteristics

Pyromorphite is known for occurring in shades of green (like above right), from deep forest greens through richer and brighter hues, then into the yellow-greens, like the color of olivine (peridot). Pyromorphite also forms lovely yellow crystals; unusual orange crystals take their coloration from arsenic.

The crystals of pyromorphite are often barrel-shaped and sometimes hollow. Single crystals are rare, though



Pyromorphite from the Daoping Mine, Zhuang Autonomous Region, China. Source: Wikipedia; photo—Rob Lavinsky.

micromounters can probably mount one. Like the samples shown here, pyromorphite commonly forms clusters, with the best specimens being lustrous.

When calcium replaces some of the lead in the crystal lattice (structure), the specimens are lighter in weight (with less lead) and usually lighter in color, too.

With a chemical formula of  $Pb_5(PO_4)_3Cl$ , pyromorphite can be used as a lead ore if lead is present in sufficient quantities—though as a mineral collector, I don't want to think of crystalized specimens going through the mill!

Pyromorphite forms a solid solution series with mimetite ( $Pb_5(AsO_4)_3Cl$ ), so some specimens may be somewhere along the spectrum from pure pyromorphite to pure mimetite. In fact, these two minerals are good examples of a solid solution series—that is, minerals that share very similar chemical formulas but have chemical substitutions that form a range in the composition from one mineral to the other.

Vanadinite ( $Pb_5(VO_4)_3Cl$ ) also forms a chemical series with pyromorphite, although intermediate specimens (chemically between pyromorphite and vanadinite) are rare and unknown to me.

Pyromorphite is a secondary mineral, forming through the oxidation of primary lead minerals and ores. So where there is lead, there may be pyromorphite. Pyromorphite isn't rare, although excellent specimens are always sought by collectors.

Pyromorphite can even form from biological processes! *Paecilomyces javanicus*, a mold in lead-polluted soil, can form biominerals of pyromorphite.

### Localities

We are fortunate to have a former major pyromorphite locality in the United States. The Bunker Hill Mine in the Coeur d'Alene District of Idaho was a significant source of specimens at all prices for many years. Although mining began in the 1880s, most mineral specimens came out in the 1980s and 1990s.

The mine is now closed and is a superfund site. Unfortunately, mining polluted the Coeur d'Alene River with lead and other toxic materials.

The mines near Phoenixville, PA, were another famous U.S. locality for pyromorphite. The mines closed more than a century ago, so fine specimens are rare. Collecting may still be allowed for pay at the dumps on the grounds of a local country club. Wonder whether rockhounds are welcome at the country club in collecting attire?

Easthampton, MA, has produced small though lovely crystals. Closer to home, pyromorphite has been found in several places in Virginia, although not in stunning specimens. Mindat reports it from the Morefield and Rutherford Mines near Richmond.

France is the source of some of the first and finest pyromorphite specimens. The Les Farges Mine specimens are noted for their intense green color. The Beauvoir Quarry in the French Alps produced delicate, tiny crystals.

Broken Hill, Australia, is another noted specimen locality, and China is currently producing nice specimens. Germany and Mexico are also sources of pyromorphite specimens.

Although pyromorphite can be faceted or used as a gem, specimens are seldom large enough and fracture-free, and wearing lead-based minerals or gems is not advisable. Pyromorphite is an unusual gemstone for these reasons. ➤

### Technical Details

Chemical formula ..... $Pb_5(PO_4)_3Cl$   
 Crystal form .....Hexagonal  
 Hardness .....3.5–4  
 Specific gravity .....6.5–7.1



**Top:** Pyromorphite from New South Wales, Australia.  
**Bottom:** Pyromorphite from the Bunker Hill Mine in Idaho.  
 Source: Smithsonian Mineral Gallery; photo—Chip Clark.

Color..... Usually green, though also orange, yellow, brown, white, rarely colorless  
 Streak..... White  
 Cleavage ..... None  
 Fracture..... Subconchoidal  
 Luster..... Vitreous, resinous

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## Pyrrhotite

by Sue Marcus

Source: *The Mineral Newsletter*, January 2018.

We begin 2018 with a Mineral of the Month that is interesting for many reasons.

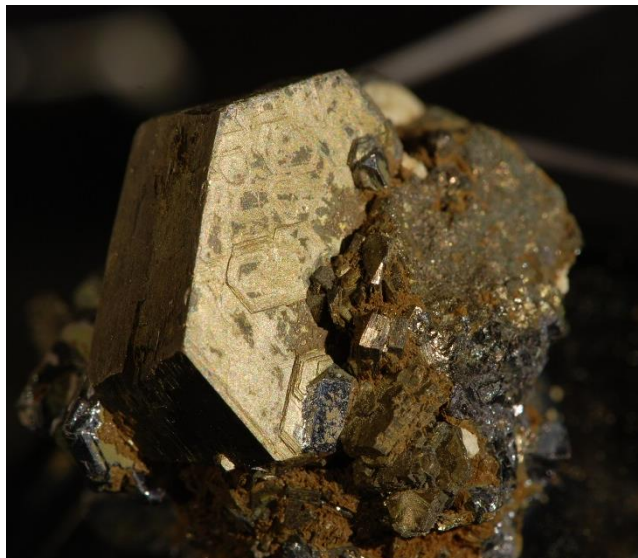
Pyrrhotite has an interesting name. It is useful. It can glitter! And I have a special fondness for it, which I will explain later.

Pyrrhotite is an iron sulfide, with a basic formula of  $\text{Fe}_7\text{S}_8$ . “Polytype” is a word I learned in my research on this mineral: it means that chemically identical materials may be structured slightly differently. In the case of pyrrhotite, crystals classified as monoclinic may appear to be hexagonal. These polytypes are called pseudo-hexagonal crystals.

Temperatures of formation above 254 °C result in pseudo-hexagonal crystals; below that, monoclinic crystals form. The amounts of iron and sulfur in the mineral chemistry can also vary by units of one each, increasing from  $\text{Fe}_7\text{S}_8$  to  $\text{Fe}_{11}\text{S}_{12}$ . Therefore, the more technical version of the chemical formula is  $\text{Fe}_{(1-x)}\text{S}$  ( $x = 0$  to 0.2). Pyrrhotite is common but not simple!

In 1847, French mineralogist Ours-Pierre-Armand Petit-Dufrénoy named pyrrhotite based on the Greek word *pyrrhos* (flame-colored), perhaps due to glints of red in slightly tarnished, brassy specimens.

The terms “splitters” and “joiners” refer to different kinds of scientists. Splitters like to *split* groups such as



Pyrrhotite from Santa Eulalia, Chihuahua, Mexico.  
Photo: Bob Cooke.



Pyrrhotite from the Nicolai Mine, Primorskiy Kray, Russia.  
Source: Smithsonian Mineral Gallery; photo: Chip Clark.

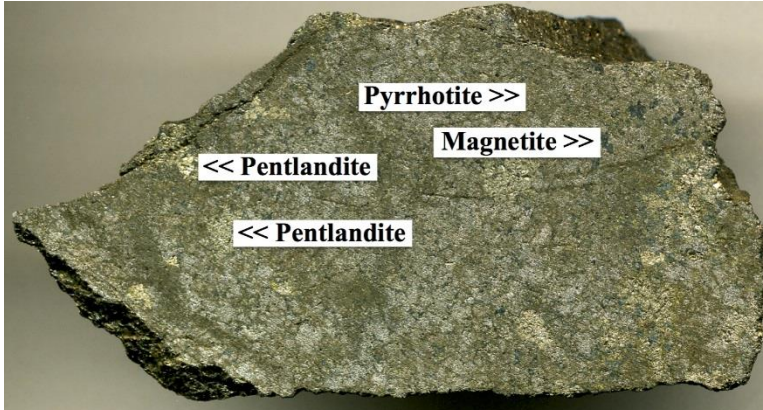
fossil brachiopods into ever smaller groups based on taxonomy or other factors. Joiners prefer to *join* groups like those same brachiopods into larger categories.

Many mineralogists have become splitters. Mindat reported a polytype of pyrrhotite called pyrrhotite-4M. This is a split (or distinction) that most mineral collectors will never notice—or find relevant. Mindat also notes two varieties of pyrrhotite: cobaltian pyrrhotite and nickeloan pyrrhotite. Most collectors and mineral dealers know all these simply as pyrrhotite.

Pyrrhotite is weakly magnetic. It is usually found in dark, iron-rich igneous and metamorphic rocks, occurring less frequently in pegmatites. Common minerals like quartz or calcite form collectible crystals in many settings; by contrast, the geologic conditions for forming pyrrhotite crystals are much more limited.

Pyrrhotite is typically intergrown with other sulfide minerals in deposits known as massive sulfides that are mined for nickel, copper, zinc, gold, silver, and other metals. Pentlandite is the primary nickel ore, and it is usually intergrown with pyrrhotite. These deposits of literally heavy minerals leave few spaces for crystals to grow. Their weight crushes potential voids.

I'm most familiar with pyrrhotite associated with pentlandite in nickel deposits. In this geologic environment, it is relatively common in Manitoba, Canada, though not in euhedral crystals



*Pentlandite intergrown with other minerals, including pyrrhotite. This specimen is from the a nickel mine, the South Mine in the Sudbury Impact Structure, Ontario, Canada. Source: Wikipedia; photo: James St. John.*

The most notable localities for collectible crystals are Dal'negorsk, Primorskiy Kray, Russia, and the Potosí Mine, Santa Eulalia District, Chihuahua, Mexico. More recently, the Yaogangxian Mine, Hunan Province, China, has produced esthetic specimens of pyrrhotite, along with many other fine specimens like arsenopyrite, fluorite, and scheelite. Pyrrhotite rosettes are reported from Trepča, Kosovo.

The Dal'negorsk region includes lead, zinc, tungsten, and associated minerals like nickel-bearing pyrrhotite as well as boron and fluorite mineralization. To me, the Dal'negorsk specimens (see the example on the previous page) are the classics and the finest—large and perfectly formed, and the best ones are lustrous, too.

The Yaogangxian Mine is part of a region of tin–tungsten deposits that also hosts beryllium-, fluorine-, and molybdenum-rich minerals as well as lovely pyrrhotite rosettes.

The Santa Eulalia District was most important for silver production, although the ores also contained lead and zinc (probably with silver bound into the chemistry of the galena), with occasional nice pyrrhotite crystals. Santa Eulalia pyrrhotite may occur as lustrous elongated crystals, although the crystals are more commonly tarnished and stubby.

Like the Mexican deposits, the Trepča deposits were mined for silver as part of the silver–lead–zinc deposits found there. Fewer pyrrhotite specimens are known from Trepča, although some of those shown on Mindat are euhedral and lustrous.

The United States and Canada are not known for pyrrhotite crystals, although minor amounts of pyrrhotite may be found in many places. Pyrrhotite is even reported in Virginia; Mindat lists four localities where it is “reported valid,” which is not a stellar recommendation for collectors, unless you want to find everything you can from our own particular state!

Pyrrhotite has special memories for me. My husband, Roger, and I worked for the Manitoba (Canada) Mines Branch. Over our second anniversary, Roger was due to be sent to Thompson, Manitoba, a major nickel mining town. I'm a geologist, too, and I didn't want to spend my second anniversary alone in a new city (Winnipeg), so I asked to go along.

Yes, I got an all-expenses-paid trip to Thompson, Manitoba, for my second anniversary! We did go to one of the active mines and brought back some pyrrhotite–pentlandite ore while we were socked in by the weather. But that's another story. ↗

### Technical Details

Chemical formula.....	Fe <sub>7</sub> S <sub>8</sub>
Crystal form.....	Monoclinic
Hardness.....	3.5 to 4
Density.....	4.58–4.65 g/cm <sup>3</sup> (measured); 4.69 g/cm <sup>3</sup> (calculated)
Color.....	Dark bronze, metallic tan
Streak.....	Dark gray-black
Cleavage.....	None
Fracture.....	Uneven
Luster.....	Metallic, micaceous
Tenacity.....	Brittle

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## Rhodonite

by Sue Marcus

Source: *The Mineral Newsletter*, December 2017.

The December Mineral of the Month is attractive, potentially useful rhodonite. Rhodonite and its mineral cousin rhodochrosite have several attributes in common.

Both owe their color to manganese; both can be minor manganese ores, and both form beautiful pink to red crystals. Both take their names from the Greek word  $\rho\acute{o}\delta\omicron\varsigma$  (*rhodos*), which translates to “rose.”

Whereas rhodochrosite is a manganese carbonate, rhodonite is a manganese silicate, which makes it significantly harder than rhodochrosite. They are close cousins but rarely occur together.

Rhodonite was initially described in 1819 by Christoph F. Jasche from material found at the Kaiser Franz Mine (later called the König Wilhelm Mine) in the Harz Mountains of Saxony-Anhalt, Germany. The type locality seems to have produced only massive to subhedral rhodonite, so unfortunately Herr Jasche did not have the exquisite crystals that have since been found to help him identify this species.

Researching these articles is always a learning experience for me. This time, I learned about the varieties of rhodonite, which Mindat lists as dyssnite, fowlerite, hsihutsunite, and orlets. Wikipedia refers to fowlerite and bustamite as separate mineral species, whereas



*Rhodonite from the Chiurucu Mine, Peru.*  
Source: Smithsonian Mineral Gallery; photo: Chip Clark.

Mindat considers only bustamite a separate species. Since Mindat follows the International Mineralogical Association naming conventions, I defer to Mindat.

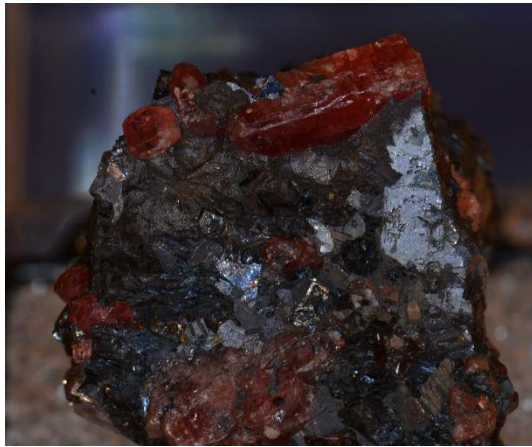
Dyssnite contains higher valences of iron and manganese but is still chemically rhodonite. Fowlerite adds some zinc and more calcium to the usual rhodonite crystal lattice. Hsihutsunite is unusually high in calcium and is deep red to purple in color.

Orlets—such an odd name in the mineral world!—is the type of rhodonite that is familiar to many people as a lapidary material. It is described as quartzlike, which I believe means fine-grained in this context. It is rich in manganese, though low in magnesium and iron. It forms at lower temperatures in skarns (where hotter fluids alter surrounding, usually calcium-rich, rock).

Orlets is familiar to many of us as the pink rock with black manganese oxide bands and blobs that can be slabbed and cut into lovely cabochons. Just as dendrites can be imagined as scenes in agate, these man-



*Rhodonite with manganese oxides (like this specimen from Humboldt County, NV) is often used in lapidary work.*  
Source: Wikipedia; photo: Chris Ralph.



*The color of rhodonite can range from pink to reddish-brown. Photos: Bob Cooke.*

gane features, in the hands of adept lapidaries, can create scenic landscapes.

With its lapidary uses, rhodonite is a semiprecious gemstone—in fact, it is the state gemstone of Massachusetts. The largest faceted rhodonite is an emerald-cut 3.6-carat stone from Broken Hill, New South Wales, Australia. This “large” gemstone is only 10.6 by 7.2 millimeters in size. The easy cleavage and rarity of flawless specimens of significant size usually preclude the use of rhodonite as a faceting material.

Rhodonite from the Ural Mountains, near Yekaterinbug, Russia, was carved (along with malachite and lapis) into fabulous vases for Russian royalty. Mineral deposits near Franklin, NJ, were primarily mined for zinc, but the area is also noted for classic rhodonite crystals. Rhodonite was one of the most colorful minerals found there, although only rare, weak, deep-red fluorescence has been reported. The Franklin/Ogdensburg/Sterling Hill region was the best U.S. source of rhodonite specimens.

Maine, Massachusetts, Montana, and New Hampshire are also prominent producers of rhodonite specimens, although localities are reported in many other states, including Virginia. Most localities produce massive material rather than crystals. Mindat doesn’t include any photographs of rhodonite from Virginia, so if you have a nice piece, you could share it there.

Pajsbergite is the local name for rhodonite from Värmland, Sweden. The manganese mines there produced massive pink rhodonite and rare, small, deep-pink or red crystals.

The most spectacular rhodonite crystals have been found at the Broken Hill Mine in New South Wales, Australia, and the Morro da Mina in Minas Gerais, Brazil. The Broken Hill specimens were found many years ago. Mindat shows one translucent crystal that is 20 millimeters long! The Australian specimens tend to be fractured, commonly on galena matrix, and are usually on the darker purple-red end of the rhodonite color spectrum. The best Brazilian specimens are more cherry red, transparent to translucent, and gemmy; others may be pink and opaque.

Peru is another source of lovely pink rhodonite crystals, like the specimen on the previous page, upper right (found in a silver and tungsten mine). The Peruvian material usually forms opaque clusters, though Mindat shows some aesthetic translucent pink crystals.

Rhodonite can be mined as a manganese ore. Manganese is used in steel production to remove sulfur from the iron ore and as an alloy in the final steel products. The United States does not produce any manganese. Our primary import sources are Gabon and South Africa. Rhodonite is not a primary manganese ore—as a silicate, it would be difficult to process, and there isn’t a lot of rhodonite to mine. ↗



*Rhodonite from Franklin, NJ (in the James Madison University collection). Photo: Tom Tucker.*



*Rhodonite on cummingtonite, Morro da Mina Mine, Conselheiro Lafaiete, Minas Gerais, Brazil.  
Source: Wikipedia; photo: Parent Géry.*

### Technical Details

Chemical formula ..... $\text{CaMn}_3\text{Mn}(\text{Si}_5\text{O}_{15})$   
 Crystal form ..... Triclinic  
 Hardness ..... 5.5 to 6.5  
 Density .....  $3.57\text{--}3.76 \text{ g/cm}^3$  (measured);  
                                    $3.726 \text{ g/cm}^3$  (calculated)  
 Color ..... Red, pink; with more iron,  
                                   can be red-brown  
 Streak ..... White  
 Cleavage ..... One very good cleavage;  
                                   cleaves easily  
 Fracture ..... Conchoidal  
 Luster ..... Vitreous, sometimes pearly  
                                   on cleavages

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## Scheelite

by Sue Marcus

Source: *The Mineral Newsletter*, October 2017.

Scheelite is a major ore of tungsten. It is found around the world, forming attractive crystals from many localities.

Baron Axel Fredrik Cronstedt, one of the first people to study the science of minerals, was an eminent Swedish mineralogist and chemist. In 1751, he discovered the original material of scheelite in the copper mines of Bispsbergs Klack, Säter, Dalarna, Sweden. He called it *tung sten* (tungsten in English), using the Swedish term for heavy stone.

In 1781, Karl Wilhelm Scheele, a Swedish chemist, realized that a metal could be extracted from this mineral. The mineral name became scheelite (for Scheele) with “tungsten” reserved for the metal.

Scheelite fluoresces light blue or blue-white in short-wave ultraviolet light, most commonly as blebs in the country rock. The less common lovely crystals of scheelite will also show this identifying trait.

Although it is not phosphorescent, scheelite is thermoluminescent. Mineral collectors and geologists who explore for economic mineral deposits use scheelite's fluorescence to locate it.

Parts of California and Nevada that attract these seekers hold a surprise. Scorpions fluoresce in a bluish color quite similar to that of scheelite. They live under rocks—think of collectors turning over rocks to seek



*Scheelite crystals on muscovite from Mt. Xuebaoding, Pingwu, Mianyang Prefecture, Sichuan Province, China.*

Source: Wikipedia; photo: Rob Lavinsky.



*Scheelite from China.*

Source: Smithsonian Mineral Gallery; photo: Dana Penland.

scheelite. Well, if it moves, it is *not* scheelite! And if it stings, it is *definitely* not scheelite!

Exploration geologists can search for scheelite as a mineral associated with gold in some geologic environments. It can be found in skarn deposits, which occur when hot mineralized fluids pervade, leach, and replace the carbonate-rich country rock. It also occurs in pegmatites and vein deposits.

Scheelite is mined for tungsten. Most tungsten ore is processed into tungsten carbide, used for cutting tools and abrasives. China is the world's largest tungsten producer.

The United States has one primary scheelite producer near Wendover, UT. Scheelite Metals LLC opened the Fraction Mine in Gold Hill, UT, in about 2013. Sadly, I could find no indication of any crystalized specimens.

Beautiful orange scheelite crystals with perfect muscovite crystals from Sichuan, China, have been on the market for the past few years. Shardu and Gilgit, Pakistan, are other recent sources of fine crystals. Crystals from these localities are usually pseudo-octohedral or dipyramidal, even though the structure adheres to the tetragonal crystal system.

In the United States, the Camp Bird Mine, near Ouray, CO, was a source of lustrous golden to brown crystals in the 1970s and 1980s. Scheelite was mined in Kern County, CA, and crystalized specimens were recovered there.

Scheelite can be faceted into gems of great beauty and sparkle. But the gems are very fragile because they are brittle and the mineral is relatively soft. The largest known cut stone is a 58-carat hunk from Namibia. ↗

### Technical Details

Chemical formula .....  $\text{Ca}(\text{WO}_4)$   
Crystal form..... Tetragonal  
Hardness ..... 4.5 to 5  
Density.....  $6.1(2) \text{ g/cm}^3$  (measured);  $6.09 \text{ g/cm}^3$  (calculated)  
Color ..... Dark brown to black, orange; less commonly tan-yellow, green, white  
Streak ..... White  
  
Cleavage ..... One good cleavage, one fair parting  
Fracture..... Irregular  
Luster..... Resinous to adamantine

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*Scheelite on muscovite from Mt. Xuebaoding, Pingwu, Mianyang Prefecture, Sichuan Province, China. Source: Wikipedia; photo: Rob Lavinsky.*

## Scorodite

by Sue Marcus and Hutch Brown

Source: *The Mineral Newsletter*, June 2016.

Scorodite is a collector's dream—and sometimes as hard to find in nice crystals. Johann Friedrich August Breithaupt first described this new mineral from material found in Saxony, Germany, where he was a professor at the Freiberg Mining Academy. In 1818, he named it after the Greek word *skorodon*, which alludes to the garlicky smell of arsenic when the mineral is heated.

Scorodite is a hydrated iron arsenate with the chemical formula  $\text{FeAsO}_4 \cdot 2\text{H}_2\text{O}$ . The mineral arsenopyrite,  $\text{FeAsS}$ , can alter to scorodite through oxidation; this secondary (second to the original mineral) occurrence is the most common geologic setting for scorodite. More rarely, scorodite also occurs as a primary mineral in hydrothermal deposits, sometimes as a crust precipitated on the outer rims of hot springs. It weathers into limonite (an iron ore).

Scorodite is in the orthorhombic mineral system. Its crystals can form dipyrramids that look like octahedrons and resemble the much harder gem mineral zircon. The color of scorodite is variable; it can be deep purple or brown (like the sample on the right), but it is best known for bright green or blue colors.

Scorodite has an adamantine or vitreous luster. Its streak is greenish-white, and its hardness on the Mohs scale is 3.5 to 4. It has poor cleavage, a conchoidal fracture, and a specific gravity of 3.27.

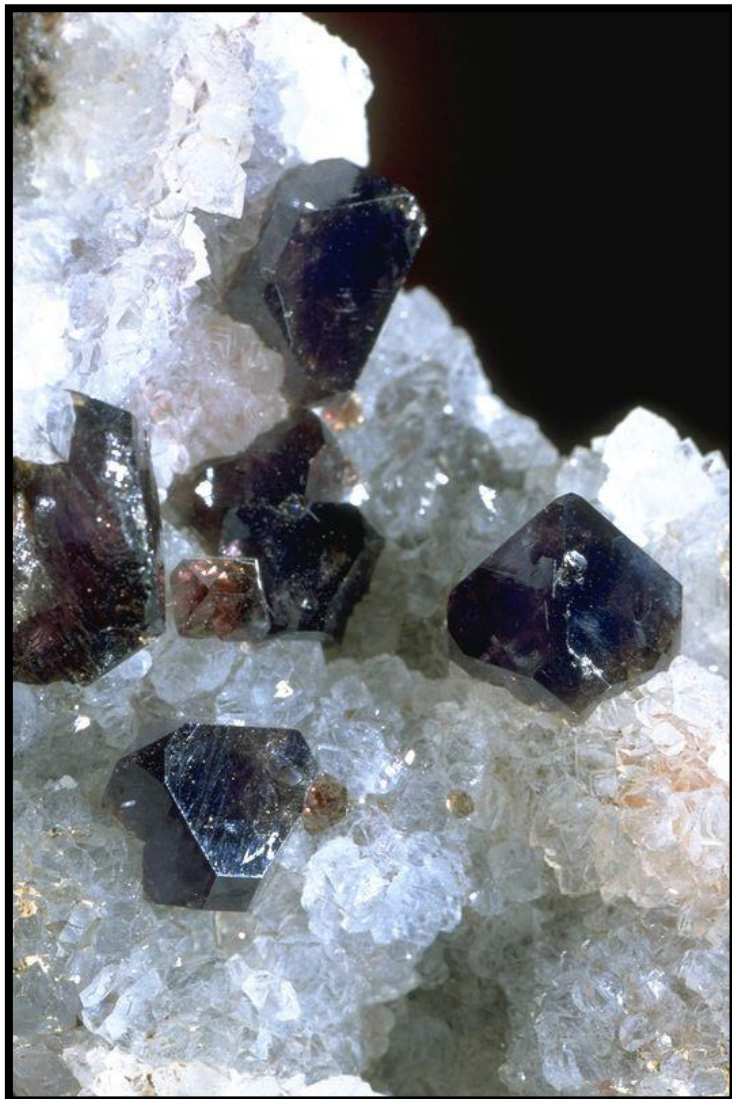
In the United States, scorodite has been found at Gold Hill, Tooele County, UT, and in the Tintic district, Juab County, UT. It also occurs in the Majuba Hill mine, Antelope district, Pershing County, NV. ↗

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Scorodite from Mexico, crater of Papacatepetl.  
Source: Smithsonian Mineral Collection; photo: Chip Clark.

## Siderite

by Sue Marcus

Source: *The Mineral Newsletter*, May 2017.

**S**iderite (SIDD-er-ite) is a relatively common mineral, although lustrous crystals are harder to come by. Its name comes from the Greek word for iron (*sidero*). I was unable to confirm the source of the originally described material (the type locality), although it may be Příbram, Czech Republic.

Since it is relatively common, siderite is widely found around the world. The Harz Mountains of Germany are a classic older location for lovely crystals. France, notably Isère, has produced rare, unusually gemmy green siderite. The Mamarues iron mines in Romania have also produced specimens desired by collectors. Panasqueira, Portugal, is another often-mentioned locality for well-crystalized specimens. Some of the mines in Cornwall, England, also produced collectible samples. Large crystals have been found in Huanavelica, Peru. The famous Minas Gerais district of Brazil has been the source of lovely gemmy siderite—along with a plethora of other dazzling minerals. Gemmy specimens have also been recovered in Potosí, Bolivia. Tsumeb, Namibia, the source of many mineral lovelies, has provided siderite crystals too. The Aggeney's Mine in Cape Province, South Africa, has produced unusual hand-sized hollow siderite pseudomorphs after calcite crystals. China, being large and rich in minerals, is also a source of siderite, notably opaque beige crystals that contrast nicely with purple fluorite.

Closer to home, Mont St. Hilaire, the world-class locality in Quebec, has produced some large siderite crystals. Rapid Creek, Yukon, has produced siderite, with some of the rare phosphates found there. In the United States, the Eagle Mine in Gilman County, CO, is probably the source of the best specimens. There are many other places where siderite crystals have been found—too numerous to mention. And with a mineral that forms easily and is common, we can hope for new discoveries in the future.

Maybe prices will come down? I can hope!

Elemental substitution may occur in the chemistry of siderite. Siderite forms a series with rhodochrosite, meaning that iron (Fe) and manganese (Mn) can substitute for each other in varying amounts (siderite is



*Siderite from Kamariza, Laurion, Greece. Photo: Bob Cooke.*

$\text{FeCO}_3$  and rhodochrosite is  $\text{MnCO}_3$ ). Similarly, zinc and magnesium may substitute for iron, with siderite also forming series with smithsonite ( $\text{ZnCO}_3$ ) and magnesite ( $\text{MgCO}_3$ ).

I have never seen mineral species intermediate between these chemical end members. Have you? If so, I'd be interested in learning more, so please share your experience and knowledge.

Siderite crystals, like the minerals with which it forms series, are often curved rhombs; and for siderite, the crystal faces are commonly striated. As a carbonate mineral, siderite breaks down easily, altering into iron oxides like goethite and limonite. Other, similar minerals include calcite and dolomite. But with its iron content, siderite is notably heavier than these carbonates.

A couple of references mentioned that the color of siderite ranges to black, with that coloration due to manganese. Yet it is not considered rhodochrosite—and certainly isn't red. I confess that I don't understand the chemistry of black siderite.

Siderite forms at low temperatures. It is most commonly found in sedimentary rocks and has formed concretions around what became fossilized remains of living organisms—a definite indicator of low-temperature formation. The famous fossils of Mazon Creek,

IL, are often preserved in siderite nodules or concretions. Siderite concretions may begin to form around pieces of another iron mineral, such as pyrite.

Siderite occurs in hydrothermal deposits with fluorite, barite, and galena. These deposits formed at relatively low temperatures, though not at the Earth's surface, like the siderite concretions.

Metamorphic and igneous processes may create siderite too. For example, massive siderite deposits formed from the alteration of dolomite by hydrothermal fluids. Siderite also forms botryoidal crusts and massive deposits. Biological processes are reported to form siderite; this may occur by microbes or bacteria breaking down iron and carbonate in the host rocks of sediments and combining them to form siderite.

Siderite can be mined for iron. From at least the early 20th century on, siderite was permanently surpassed for iron production by hematite and magnetite, which are richer in iron and occur in more massive deposits, making them easier to mine and process. The Russian province of Kaluzhskaia is the only reported economic source of siderite that is used for pigment.

Due to its inherent tendency to fracture and its relative softness (lack of durability), siderite is cut as a gemstone more often as an oddity than to be used in jewelry. Cabochons may be cut from massive material, although they too will scratch easily.

So: lovely to look at but impractical to wear! ↗

### Technical Details

Chemical formula.....  $\text{FeCO}_3$   
Crystal form..... Trigonal  
Hardness ..... 3.75–4.25 (Wikipedia); 3.5–4.5 (Mindat)  
Density.....  $3.95 \text{ g/cm}^3$  (measured); 3.83–3.89 (Gemdat)  
Color ..... Usually brown; ranges from yellow to very dark brown, less often black  
Streak ..... White  
Cleavage ..... Perfect on {0111}  
Fracture ..... Brittle, with small conchoidal fractures  
Luster ..... Vitreous to pearly



*Siderite from Mont St. Hilaire, Quebec, Canada.  
Photo: Bob Cooke.*

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## Smithsonite

by Sue Marcus

Source: *The Mineral Newsletter*, March 2017.

When you think of smithsonite, does your mind's eye, like mine, drift fondly to the aqua hues of specimens from the famous Kelly Mine, like the one featured on the right? Or do you have a favorite smithsonite in one of its other rainbow colors or forms?

Smithsonite is an easy mineral to enjoy and to collect—at least by the “silver pick” (purchasing rather than self-collecting). In its botryoidal forms, the bumps and lumps may be pink, green, yellow, white, or that lovely “Kelly blue,” along with other shades, including brown.

Or smithsonite can form attractive individual crystals, rarely large, though frequently transparent or translucent. Mindat (2017) showed 3,725 photos of smithsonite. Smithsonite is photogenic and abundant enough for collectors to have enough specimens to share beautiful images.

Chemically, smithsonite is zinc carbonate, with the formula  $ZnCO_3$ . Zinc ores have been known and exploited for ages—literally! Zinc was used to make bronze as early as 3000 BC. Georgius Agricola (the early German mineralogist born as Georg Bauer in his native Saxony—*Bauer* and *agricola* both mean farmer) used the term “Lapis calaminaris” for zinc ore in his best known and foundational book on mining, *De Re Metallica*, published in 1556.

You might think, with a name like smithsonite, that the type locality where the mineral was originally found and described would be in England (land of James Smithson, of Smithsonian fame). The mineral was indeed named for him by François S. Beudant in 1832. However, calamine was the name used by the Swedish mineralogist Johan Gottschalk Wallerius (or Vallerius) for zinc carbonate in 1747; for reasons unknown to me, that name did not stick with the mineral.

Another Swede, Torbern Bergmann, analyzed calamine samples in 1780 and found mixtures of zinc carbonate and silicate. In 1803, James Smithson, following up on the work of Bergmann, studied calamine ores more thoroughly and discovered that they comprised two separate minerals, a carbonate and a silicate. It was the carbonate identified by Smithson that was eventu-



Smithsonite with aurichalcite, Kelly Mine, New Mexico.  
Photo: Tom Tucker.

ally named to honor him. The silicate became hemimorphite. According to Dana (1966), the mineral name calamine is now used for the chemical compound  $(ZnOH)_2SiO_3$ .

Coloration in smithsonite can be caused by trace amounts of iron, manganese, cobalt, cadmium, indium, or even abnormal amounts of calcium in the crystal lattice (structure). Green or blue smithsonite contains traces of copper. Cobalt causes the pink color in smithsonite, just as it does in calcite. Iron turns smithsonite brown or orangey-brown. Cadmium causes a yellow or orange color; recent specimens of cadmium-rich smithsonite from China are pricey, and some of the yellow ones fluoresce.

The yellow form is sometimes called “turkey-fat ore.” Miners called honeycombed, fine-grained, brown or off-white, massive smithsonite “dry bone ore,”

although they sometimes used the term more loosely for all forms of smithsonite.

Along with its variety of colors, smithsonite occurs in a variety of forms. It is commonly botryoidal, although it can also form stalactites and stalagmites. Large rhombohedral crystals are relatively rare. Scalenohedrons are also found.

As a zinc ore, smithsonite has a geologic affinity for ores rich in galena and sphalerite, so the three minerals are often found together. Smithsonite forms at low temperatures and pressures from the oxidation of sphalerite, so it is found towards the top of ore deposits. Therefore, it is a “supergene” ore—superposed above the original orebody.

Hemimorphite, another supergene zinc mineral, and cerussite, the lead carbonate analogue to smithsonite, also occur together.

The Kelly Mine in New Mexico is the source of many famous eye-catching specimens—and of smaller favorite pieces for the rest of us. Ask Tom Tucker to tell you about collecting at the Kelly Mine. Perhaps Pat Hayes and Fred Parker, who moved to that area, have collected there, too.

Tsumeb, Namibia, though a major copper producer, also has beautiful smithsonite specimens. Botryoidal pink specimens have been found there, along with clear, white, yellow, and green macrocrystals. If you browse through the pages of photos of smithsonite on Mindat, you’ll see that Tsumeb has produced every possible color and form of smithsonite.

Mexico also produces beautiful smithsonite specimens from copper and zinc mines in Sinaloa, Chihuahua, Zacatecas, and other states.

The type locality for smithsonite is difficult to discern. I believe it is the Singing River Mine, Shipham, Mendip Hills, Somerset, England (Pracejus 2015), because smithsonite, as a mineral material, was known long before it was named. The Mendip Hills locality is probably where James Smithson’s material came from.

According to Gemdat (2017), smithsonite is cut and polished as a gemstone in faceted and cabochon forms. But I wouldn’t advise wearing it unless it is well protected from abrasion because the mineral is relatively soft. A quirky fact is that “Bonamite” is the name given to cabs made from smithsonite. Some sources also state that the term “Bonamite” is used for any smithsonite in the gem trade. ↗



Source: Wikipedia; photo: Rob Lavinsky.

## Technical Details

Chemical formula.....	ZnCO <sub>3</sub>
Crystal form .....	trigonal
Hardness .....	4–4.5 (Mindat 2017); 5–5.5 (Gem.dat 2017); 5.5 (Dana 1966)
Density .....	4.42–4.45 g/cm <sup>3</sup> (measured)
Color .....	almost any—aqua, green, orange, yellow, pink, white, clear
Streak.....	white
Cleavage.....	perfect in one direction
Fracture .....	usually irregular
Luster.....	pearly, vitreous, silky when botryoidal

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## Sperrylite

by Hutch Brown

Source: *The Mineral Newsletter*, June 2017.

Sperrylite, as you can tell from the cover, can come in gorgeous crystals. It looks a lot like pyrite—in fact, it is part of the Pyrite Group—but it is silvery white rather than brassy yellow in hue.

Sperrylite is a commercially viable ore for one of the world's most precious metals: platinum. That, plus their rarity, makes collectible specimens of sperrylite very expensive. Good specimens can range in price from hundreds to thousands of dollars.

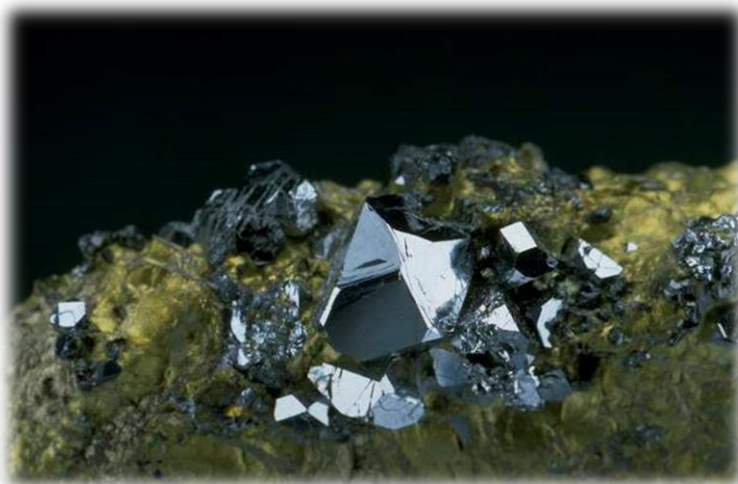
Sperrylite was discovered in 1887, when Francis L. Sperry, a chemist for the Canadian Copper Company in Sudbury, Canada, collected it in the Vermillion Mine in the District of Algoma, Ontario. The mine was for gold ore in quartz; Sperry found the mineral in loose gravel together with copper and iron pyrites. He sent it to Horace L. Wells for testing, and Wells identified it as a hitherto unknown “arsenide of platinum” (PtAs<sub>2</sub>). He named it “Sperrylite” in honor of Francis Sperry.

Though rare, sperrylite is the most common platinum mineral. It generally occurs with other unusual minerals, such as cooperite ([Pt,Pd,Ni]S), laurite (RuS<sub>2</sub>), and niggliite (PtSn).

Formed by contact metamorphism, sperrylite crystals vary in size and shape; they are usually enclosed in a variety of host minerals, such as the chalcopyrite on the cover. With a specific gravity of 10.58, sperrylite is unusually heavy, about as heavy as silver.

Other technical details:

Crystal system.....	Isometric
Crystal habit.....	Well-formed finely crystalline, massive to reniform
Cleavage .....	Indistinct on {001}
Fracture.....	Conchoidal
Tenacity .....	Brittle
Mohs scale hardness .....	6–7
Luster.....	Metallic
Streak.....	Dark gray to black



*Sperrylite on chalcopyrite, Talnac Ore Deposit, Krasnoyarsk Kray, Russia. Source: Smithsonian Mineral Gallery; photo: Chip Clark.*

Sperrylite resists decomposition through weathering, so it can be found in alluvial deposits. In 1898, for example, it was reportedly found together with small garnets and corundums during alluvial gem mining in streams draining Mason Mountain in Macon County, NC.

Sperrylite is the only commercially important platinum ore besides native platinum. The only place where sperrylite is found in abundance is in the Sudbury Basin of Ontario, Canada, where it is mined for its extremely valuable metal. Other localities include the layered igneous complex in the Bushveld region of South Africa and the Oktyabr'-skoye copper/nickel deposit in eastern Siberia, Russia. ↗

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*Sperrylite crystal from Siberia. Source: Wikipedia; photo: Rob Lavinsky.*

## Spessartine

by Sue Marcus

Source: *The Mineral Newsletter*, October 2016.

Lovely spessartine can't seem to keep a name. This member of the garnet family was always known from the Spessart Mountains of Germany, although Martin Klaproth originally named it *granatförmiges Braunsteinerz* ("granite-shaped manganese ore") in 1797. The name became "manganesian garnet" in 1823 before François Sulpice Beudant, in 1832, bestowed its current name of spessartine, for the original locality.

Spessartine can be found in all major rock types—in metamorphic and igneous rocks as a primary mineral. In sedimentary rocks, it erodes from the other rock types and is deposited in the sediments.

As part of the Garnet Group, spessartine shares elements with a spectrum of others in the group, such as pyrope and almandine. All may form gem-quality materials. A mixture of pyrope and spessartine called Malaya garnet (an unofficial name), from Tanzania and Kenya, is used in jewelry. Malaya garnets occur in unique and rare colors, like pink-orange, red-orange, and yellow-orange.

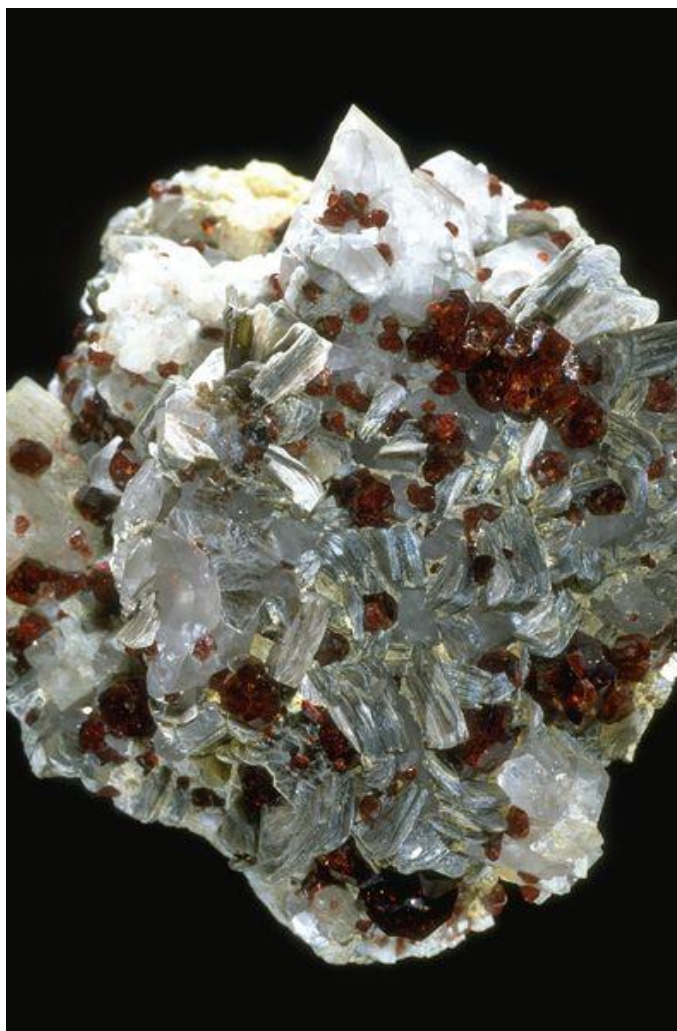
A different rare hybrid of spessartine and pyrope is reported by Gemselect.com. This variant changes color, depending on the light source. The hybrid is not truly pleochroic, because "pleochroic" applies only to doubly refractive minerals and these garnets are singly refractive.

China has been a recent source of beautiful spessartine specimens. The bright orange-red spessartine crystals



Spessartine on albite, Wushan Spessartine Mine, Tongbei, Yunxiao, Zhangzhou Prefecture, Fujian Province, China.

Source: Wikipedia; photo: Parent Géry.



Spessartine garnet on muscovite.

Source: Smithsonian Mineral Collection; photo: Chip Clark.

stand out against white albite. The pegmatites of Afghanistan, Brazil, and Pakistan are also significant spessartine producers. An orange variant is found in Madagascar; closer to home, violet-red spessartines come from Colorado and Maine. San Diego County, CA, has been the main spessartine producer in the United States, with an estimated 40,000 to 50,000 carats of faceting-grade rough material mined between 1956 and 1994.

A challenge for collectors is knowing when the garnet you found is spessartine. It is usually impossible to tell without extensive and often expensive analysis. My rule of thumb—and it is no more than that—is to find well-referenced literature on the collecting locality and go with what is given there. That may be the wimpy route—you may have found something new for your

locality, though getting it verified as such may be difficult.

While looking at sources for this article, I noticed that even high-end dealers like John Betts listed many of the garnet specimens as “Almandine-Spessartine,” presumably because it was somewhere along that part of the Garnet Group spectrum. Garnets are relatively easy and fun to find, so happy and safe collecting! ↗

### Technical Details

Chemical formula ..... $\text{Mn}_3^{2+}\text{Al}_2(\text{SiO}_4)_3$  (good printing that one!)

Crystal form ..... Isometric

Hardness ..... 6.5–7.5

Density ..... 4.12–4.32 g/cm<sup>3</sup> (measured)

Color ..... Usually deep or dark red, to slightly purplish red, brown, less frequently orange

Streak ..... White

Cleavage ..... None

Fracture ..... Subconchoidal

Luster ..... Vitreous

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*Spessartine crystals on smoky quartz, Wushan Spessartine Mine, Tongbei, Yunxiao, Zhangzhou Prefecture, Fujian Province, China. Source: Wikipedia; photo: Parent Géry.*

## Sphalerite

by Sue Marcus

Source: *The Mineral Newsletter*, September 2017.

Sphalerite (zinc sulfide, or ZnS) is relatively common, simple, and collectible, whether by silver pick (money) or self-collecting, even trading.

### Chemical Affiliations

By simple, I mean that there are few chemical complications. Admittedly, sphalerite does have several varieties: Marmatite is the iron-rich, usually opaque black variety; cleiophane is the light yellow variety; and ruby blende is the orange to red variety.

In decades of collecting, however, I've come across the term "marmatite" only from mineral dealers and other collectors. Also, sphalerite is most commonly brown or cinnamon-colored, so these special varietal terms aren't used frequently.

If manganese was abundant and available during its formation, sphalerite might grade into alabandite (MnS). If there was sufficient iron, it might have become wurtzite (Zn,Fe)S.

There seems to be some debate about another potential polymorph, matraite (also ZnS). From what I could find, that name was discredited by the International Mineralogical Association in 2006, so matraite is not an approved mineral name or species.

Sphalerite is frequently found with the ore minerals galena (PbS) and chalcocite (Cu<sub>2</sub>FeS<sub>2</sub>). They often occur together due to the chemical affinity of their main cations—zinc, lead, and copper.



Sphalerite from Penfield, Monroe County, NY.

Photo: Bob Cooke.



Sphalerite on chert breccia from Picher, Oklahoma. Photo: Tom Tucker.

### Etymology

The affinity in geological environments may have led to the naming of sphalerite, for the word is derived from the Greek term for "mistaken" or "treacherous." Miners thought that sphalerite was lead ore (galena) and then found that it lacked the lead they sought.

The name was finally bestowed by Ernst F. Glocker after earlier references to the material as "blende" or "zincum." "Blende" is still a miner's term for sphalerite.

### Occurrence and Uses

Sphalerite most commonly occurs in hydrothermal deposits, where heated fluids have percolated through the host rocks and deposited the ore minerals.

Sphalerite is the main ore for zinc; most of this mineral is extracted for industrial use. The United States has 12 zinc mines in 5 states (2016 data, USGS).

Most zinc is used for galvanizing (coating steel or iron to prevent rust). Sphalerite is also an important source of byproduct cadmium, gallium, germanium, and indium.

### Personal Connection

Now a digression.

This is a mineral that helped inspire my career in geology. As a kid, I was given a hand-me-down mineral collection, and someone suggested that I contact Dr. Edwin Roedder to identify what was what. I later

learned that Dr. Roedder was a very eminent mineralogist. He was the pioneer investigator of fluid inclusions in minerals, discerning that the inclusions held information about the geologic history of the surrounding mineral and rocks.

At the time, however, I was too young to know enough to be awed by Dr. Roedder. Every few weeks, we'd visit his home in Bethesda, MD, and he'd quiz me. Often, if I could identify the specimen, I could keep it! I learned that the specimens were frequently sphalerite from the Tri-State Mining District (Missouri/Kansas/Oklahoma). So I learned to detect and admire many variations of sphalerite.

### Localities

Along with specimens from the tristate region, the United States is known for stunning specimens from the Elmwood Mine and similar localities in Tennessee. These sites produce lustrous, sometimes translucent rich-brown-toned well-formed crystals, some with equally beautiful calcite and galena crystals.

Everyone should have a sparkling specimen of mid-western sphalerite in her or his collection. My best collecting trip was led by Barry Remer, with Frank Hisson and me along for comic relief, to a limestone



*Gem-quality sphalerite on white quartz, Changning, Hengyang Prefecture, Hunan, China.  
Source: Wikipedia; photo: Rob Lavinsky.*



*Schalenblende, Olkusz District, Poland. This 2-inch-high slab of schalenblende probably consists of layers of galena (bottom), sphalerite and wurtzite, and marcasite (top). The marcasite formed last and is slowly disintegrating.*

*Photo: Tom Tucker.*

quarry in Danville, KY. For one short day, we collected some very nice fluorite, sphalerite, and calcite specimens—lovely and *heavy!*

The United States doesn't have all the best sphalerite. The Mandan ore fields of Bulgaria produce unusual green sphalerite crystals that can be translucent in the best specimens. Traces of cobalt cause the green color. Peru is the source of many lovely sphalerite specimens, notably rare lustrous red crystals. Similar brilliant specimens have also come from China.

Schalenblende is a rock with bands of massive sphalerite and wurtzite, usually with galena or pyrite. It is sold in attractive polished slabs. Germany, Poland, and other parts of central Europe are the most common sources.

Mindat includes more than 5,300 photos of sphalerite, indicating that this is a photogenic as well as familiar mineral. Many apparently brown sphalerite crystals benefit from strong backlighting when photographed—they may show their reds or yellows.

The Franklin–Sterling Hill, NJ, deposits are noted for fluorescent specimens. Before becoming famous mineral-collecting localities, they were huge zinc orebodies that were mined by the New Jersey Zinc Company. The sphalerite found there fluoresces either in blue or in orange-to-yellow colors; some specimens also phosphoresce.

From micros to macros, sphalerite can appeal to everyone, even lapidarists. Bulgaria, China, Peru, and Spain are sources of sphalerite suitable for faceting. Although sphalerite can be styled into jewelry, its relative softness and brittleness make it a poor choice for normal wear. Some faceted stones exhibit a range of hues, for example from yellow to orange-red, making them attractive despite their delicacy.

### Technical Details

Chemical formula .....	ZnS or (Zn,Fe)S
Crystal form.....	Isometric
Hardness .....	3.4–5
Specific gravity.....	3.9–4.1
Color .....	Brown, black, cinnamon, green, yellow
Streak.....	White for pure material, browner if material contains more iron
Cleavage .....	Perfect in at least three directions (depends on source)
Fracture.....	Uneven to conchoidal
Luster.....	Resinous, adamantine
Fluorescence .....	Sometimes. When fluorescent, typically orange, sometimes blue

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*Tetrahedral sphalerite crystals, Idarido Mine, Telluride, Colorado. Source: Wikipedia; photo: Rob Lavinsky.*



## Spodumene

by Sue Marcus

Source: *The Mineral Newsletter*, September 2016.

Spodumene sends a mineral collector's mind off in many directions. Kunzite (the variety on the right) or maybe hiddenite; specimens or gems? It often fluoresces! Single crystal or on matrix? And can you get good location information?

Luckily for collectors, the pegmatite deposits in Pakistan and Afghanistan have been producing abundant quantities of kunzite, the light pink to purple form of spodumene, in sizes and for prices that start at a reasonable level of \$10 or less and go as high as one wants—and beyond!

Transparent forms of spodumene—kunzite and hiddenite—are pleochroic, meaning the specimens (usually crystals) appear to be darker or lighter when seen in different directions. The pink or purple color is due to manganese, while the green is usually chromium. There are exceptions—heat treating can darken or deepen the colors, particularly in kunzite, and when there is no chromium present in the green variant, it technically is not hiddenite. Webmin notes an additional form of colorless or yellow spodumene called triphane.

Spodumene was named in 1881 after the Greek word *spodoumenos*, or reduced to ashes. Sources differ on whether this refers to the color of the original material—an ashy, opaque gray—or to the looks of the material when it was incinerated. Kunzite was named for mineral collector and gemologist George F. Kunz.



Spodumene, including colorless kunzite (upper left), a pale pink kunzite gemstone, and greenish hiddenite. Source: Wikipedia.



Spodumene (var. Kunzite) from Brazil.

Source: Smithsonian Mineral Collection; photo: Chip Clark.

Hiddenite was first found in North Carolina by William Earl Hidden, a mining engineer, collector, and dealer. The town of Hiddenite, NC, was later named after the mineral found nearby.

Spodumene can be a source of lithium, and it is mined in Australia for industrial uses. Lithium is used in batteries, ceramics, medicines, and other products. China and Chile may also produce spodumene when the price is right.

In the United States, spodumene is not mined industrially. Kunzite has been found in pegmatites in California, Maine, and several other places. Along with the Afghani-Pakistani pegmatites, notable foreign localities include Brazil, Madagascar, and Mozambique.

Gigantic crystals of spodumene have been found. Minerals.net reports a 42-foot (12.8-m) crystal! Wikipedia

tops that with a report of a 47-footer (14.3-m crystal) from South Dakota. These are not gorgeous crystals; they are the opaque gray variety. ➤

### Technical Details

Chemical formula ..  $\text{LiAlSi}_2\text{O}_6$

Crystal form ..... Monoclinic (when formed below 900 °C); tetragonal (when formed above 900 °C)

Hardness ..... 6.5-7

Density ..... 3.1-3.2 g/cm<sup>3</sup> (measured)

Color ..... Clear, white, purple, green, yellow, colors in between these, and bicolor; opaque grey

Streak ..... White

Cleavage ..... Perfect, two directions; cleaves easily.

Fracture ..... Perfect

Luster ..... Vitreous

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*Spodumene from the Walnut Hill Pegmatite Prospect, Huntington, MA. Source: Wikipedia; photo: Rob Lavinsky.*

## Stibnite

by Sue Marcus

Source: *The Mineral Newsletter*, May 2016.

Wouldn't you love to find a stibnite specimen? Most of us only acquire them with a "silver pick"—that is, by using our money (silver) as a prospecting tool.

Some lustrous stibnite crystals may look slightly blue-gray, as on the right. The crystals are long and usually thin; they can look like dark, shiny straws sticking up from matrix or like a sheaf of shiny sticks lying in a heap. Some of the lovely specimens from Japan show amazing natural kinks and bends.

If you are searching for a specimen for your collection, look for perfect terminations. Decide whether you want a delicate sheaf or a sturdier single crystal—each type has its appeal. And remember, stibnite is very soft, so treat it carefully. This is also one of those minerals to remember one thing about: never place your fingers on the tips of the crystals at a dealer's table.

Stibnite is not reported from Virginia or Maryland. The closest location I could find is the Sterling Mine in New Jersey (Mindat notes: "NOT the Sterling Hill Mine"). However, the samples I found from there were not impressive enough for a photo.

The Ichinokawa Mine in Japan is the source of stunning stibnite single crystals (see the photo below), but the deposit was exhausted and the mine closed in the 1950s. The Romanian Herja Mine is noted for its clusters and sprays of stibnite crystals. China currently produces most of the world's antimony ore and most of its stibnite specimens. Several Chinese localities have lustrous specimens as sprays, intricate groups, and very large pieces.



Stibnite at the Harvard Mineralogical Museum, originally from the Ichinokawa Mine, Saijo City, Ehime Prefecture, Shikoku Island, Japan.

Source: Mindat; photo: P. Cristofono.



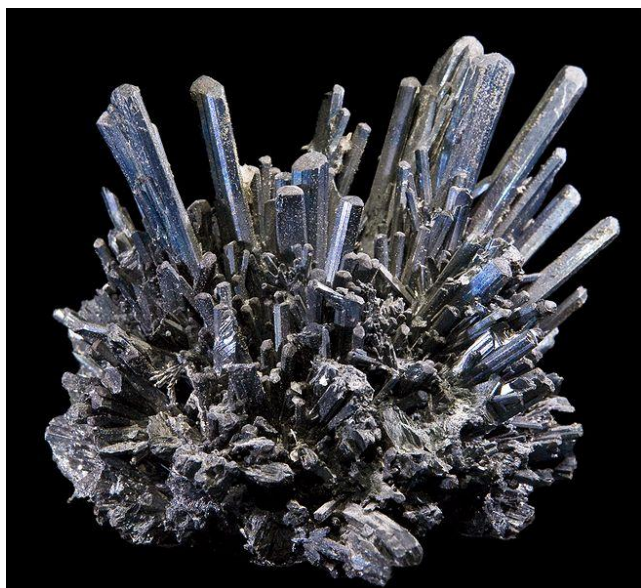
Stibnite, Ichinokawa Mine, Shikoku, Japan.

Source: Smithsonian Mineral Collection; photo: Chip Clark.

Stibnite is always opaque, and it is the main ore of antimony. Antimony has been known since ancient times, though not distinctly identified until the 16th century. The chemical symbol for antimony, Sb, was not chosen until the 1800s, when chemist Jons Jakob Berzelius named it after the Latin word for stibnite (*stibium*).

The original locality for stibnite is lost in antiquity—that is, no one knows. Cleopatra's mascara may have come from stibnite, since powdered stibnite was used by ancient Egyptians as eye makeup. A Greek physician in the 1st century AD recommended it for skin problems.

In the 17th century, European doctors used stibnite to induce vomiting. No wonder it was later found to be



*Stibnite, Herja Mine, Baia Mare, Maramures, Romania.  
Source: Wikipedia; photo: Didier Descouens.*

toxic, notably when swallowed, and irritating to the skin! Science can improve on past remedies.

Antimony, extracted from stibnite-rich ore, is primarily used to create fire-retardant materials, ranging from firefighters' work clothes to babies' crib sheets. Antimony-based chemicals are also used in the glass of our smart phones and in some of their batteries. Added to ammunition, antimony can increase its armor-piercing ability. In lesser amounts, antimony compounds are used in plastics containing PET (polyethylene terephthalate), such as soda bottles.

In the United States, Idaho has most of our stibnite, mostly in the Coeur d'Alene District. Active mining depends on commodity prices; extraction has fluctuated in the past decade. The United States imports most of our antimony from China.

Most stibnite forms in one of two geologic ways. The Idaho deposits were formed at relatively shallow depths below the Earth's surface (epithermal). They are composed of quartz veins with galena, sphalerite, gold, silver, and other minerals. By contrast, China has carbonate-replacement deposits in which limestone or dolomite has been replaced by mineralized fluids. The replacement deposits are larger and richer than the vein deposits.

My fingers sometimes type stilbite when my brain is thinking stibnite—does this ever happen to you? Stilbite is a zeolite or group of zeolites, but that's another story for another newsletter ... ↗

### Technical Details

Chemical formula.....	Sb <sub>2</sub> S <sub>3</sub>
Crystal form.....	Orthorhombic
Hardness.....	2
Density.....	4.63 g/cm <sup>3</sup> (measured); 4.625 g/cm <sup>3</sup> (calculated)
Color.....	Steely metallic gray
Streak.....	Gray
Cleavage.....	Subconchoidal
Fracture.....	Perfect
Luster.....	Metallic

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## Stilbite

by Sue Marcus

Source: *The Mineral Newsletter*, November 2016.

**B**owties: pasta, fashion, and *stilbite*! Although stilbite is usually found or collected as single crystals or as rounded masses of crystals, the bowtie or dumbbell shape is distinctive and sought by many of us. The photo on the right shows intergrown stilbite crystals in the bowtie habit.

The name stilbite (derived from the Greek word for “shine”) came from the mineral’s pearly, mirrorlike luster. Although other names were used earlier, the French mineralogist Jean Claude de la Métherie conferred the name stilbite on this mineral species in 1797, and the name stuck.

But mineralogy has its “splitters” and “joiners,” just as paleontology does. What used to be simple “stilbite” has become a series of calcium-dominant materials and sodium-dominant materials known, respectively, as “stilbite-Ca” and “stilbite-Na.” The distinction probably came about due to increased analytical precision; in identifying hand specimens, “stilbite” (with no special element designation) is therefore probably wisest.

The Zeolite Group is large and includes stilbite. Most minerals in the group, including stilbite, formed at relatively low temperatures in volcanic rocks. The Deccan Traps—vast sheets of basalt in India—are noted sources of stilbite and other zeolites. These basalt flows date to 66 million years ago and are estimated to have had a volume of 123,000 cubic miles! Lots of collecting opportunities!

Individual stilbite crystals may be several inches long (rarely) and are flat and slightly narrower in the middle (slightly hourglass-shaped). The crystals may flare at the ends; thus, when they occur as a group, they form “bowties” or “wheat sheaves.”

Along with the major Indian localities, stilbite is found in metamorphosed volcanic rocks in Scotland, Iceland, and Canada (Nova Scotia) and in younger volcanic rocks in Italy. In the United States, we can find stilbite in some of our nearby quarries, and there are famous localities in New Jersey, Oregon, and Washington state.



*Stilbite from the Jalgaon District, Maharashtra, India.*

Source: Wikipedia; photo: Rob Lavinsky.

Stilbite is too soft for lapidary work. It doesn’t seem to have any industrial or economic uses. The good news for collectors is that we can self-collect; and even when we buy specimens, they are usually affordable. But I expect you can pay as much as you want for the best pieces ... ↗

### Technical Details

Chemical formula.....	$\text{NaCa}_4(\text{Si}_{27}\text{Al}_9)\text{O}_{72} \cdot 28(\text{H}_2\text{O})$ , with Ca before Na in some forms
Crystal form .....	Monoclinic, less frequently pseudo-orthorhombic
Hardness.....	3.5–4
Density .....	2.18–2.2 g/cm <sup>3</sup> (measured)
Color .....	Usually white, though can be beige, brown, pink, light green, and orange
Streak .....	White
Cleavage.....	Perfect on (010)
Fracture .....	Conchoidal to uneven
Luster .....	Pearly

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## Sulfur

by Hutch Brown

Source: *The Mineral Newsletter*, April 2016.

**S**ulfur ( $S_8$ ), the tenth most abundant element in the universe, has been known since ancient times. The name comes from the Latin word *sulphurium*; hence the British spelling—sulphur.

In antiquity, sulfur was used in medicines and for fumigation and bleaching cloth. In some ancient religions, including Christianity, sulfur (“brimstone”) was associated with fire in the underworld, perhaps due to its connection with volcanic vents and hot springs.

In 1777, the French chemist Antoine Lavoisier first identified sulfur as an element. Sulfur is a component of such common minerals as galena ( $PbS$ ), pyrite ( $FeS_2$ ), celestite ( $SrSO_4$ ), and barite ( $BaSO_4$ ).

Sulfur crystals are found all over the world, although most of the best crystals come from Italy, including the specimen on the right (from Agrigento, a locality in Sicily famous for its crystalline sulfur). Some of our club members have found sulfur crystals at fumaroles in Nevada.

Sulfur is brittle and soft, with a hardness of 1.5 to 2.5. Typically yellow, it ranges in color from yellow-brown to yellow-green and even comes in orange and white.

Sulfur has transparent crystals in the orthorhombic crystal system and a resinous or greasy luster. Sulfur melts at 239 °F into a red liquid, and it burns with a blue flame.

Sulfur is odorless. The familiar rotten-egg smell comes from hydrogen sulfide gas ( $H_2S$ ), common in hot springs. Sulfur easily dissolves in hot water. Associated with igneous and sedimentary rocks (such as salt domes), sulfur is usually produced by injecting underground deposits with hot brines. Sadly, crystals dissolve in the process.

Sulfur is used to produce sulfuric acid ( $H_2SO_4$ ), which goes into fertilizers and lead-acid batteries as well as into many industrial processes. Sulfur is also used to vulcanize natural rubbers, as an insecticide, in the manufacture of gunpowder, and as a dyeing agent.



*Sulfur from Agrigento, Italy.*

Source: *Smithsonian Mineral Collection*; photo: Chip Clark.

Sulfur dioxide ( $SO_2$ ), formed by burning sulfur, is used as a bleaching agent, solvent, disinfectant, and refrigerant. Combined with water, sulfur dioxide forms sulfurous acid ( $H_2SO_3$ ), a major component of acid rain.

λ.

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## Sylvanite

by Sue Marcus

Source: *The Mineral Newsletter*, March 2016.

When you think of Transylvania, do you think of Dracula—or the more rare and valuable sylvanite? Yeah, me too.

I hadn't heard of sylvanite until Super Editor Hutch came up with the stunning photo on the right. So I looked it up.

Sylvanite is a rare telluride mineral with the chemical formula  $(\text{Au,Ag})_2\text{Te}_4$ . Wow—according to Mindat, it usually has a gold-to-silver ratio of 1:1! So if it is part of an ore body being mined, it is money in the bank to the mining company—no wonder there aren't many sylvanite mineral specimens!

All tellurides are relatively rare, and visible crystals are even rarer. Our micromounter colleagues have a better chance of having a nice sylvanite specimen in their micro collections than I do in my macro collection.

Tellurium was once called sylvanium and was detected in ore from the Transylvania region of Romania. Although sylvanium fell out of favor as a name for the element, the mineral sylvanite retained its name.

Sylvanite is very soft, with a hardness of 1.5–2, so it is delicate as well as rare. It is also brittle and opaque, with a metallic luster. It forms monoclinic crystals with a specific gravity of 7.9–8.3, *if you could get pure material to weigh and wanted to break your specimen.*



*Sylvanite from Romania.*

Source: *Smithsonian Mineral Collection*; photo: Chip Clark.

Photographs of sylvanite show it to be silvery to nickel-gold in color. Websites list its official color as gray, white to yellow, or silver-white. I did not see any photos showing specimens that I would consider white or yellow.

Sylvanite occurs in gold deposits in Cripple Creek, CO, as well as several other Colorado, California, Alaska, and other gold-associated localities in the United States. Specimens are also noted from gold deposits on Fiji. Sylvanite is found in many other places around the world, though never in abundance.

Although sylvanite contains gold and silver, it is mined only as a byproduct because it does not occur in sufficient quantities to be an ore on its own. ↗



*Sylvanite (silver-colored) from the Cripple Creek Diatreme in Colorado.*

Source: *Wikipedia*; photo: James St. John.

## Tennantite

by Sue Marcus

Source: *The Mineral Newsletter*, December 2016.

Researching tennantite taught me about the English Smithsons. There was James, who endowed the eponymous Smithsonian Institution. Tennantite was named in 1819 by William Phillips for another Englishman, Smithson Tennant. This chap was a chemist who discovered two new elements, osmium and indium, in platinum ores. He also identified both diamond and coal as forms of carbon. The unfortunate man died when he was riding over a bridge and it collapsed!

Just as life isn't simple, tennantite isn't either. It forms a "solid solution series" with tetrahedrite. That means that each of these minerals is on one end of a spectrum, with mixtures in between. In tetrahedrite, antimony (Sb) substitutes for arsenic (As) in the chemical formula. Iron, zinc, and silver may also occur in varying amounts, substituting for copper.

It is difficult to impossible to tell tennantite from tetrahedrite in hand samples, so using known, verified location information can be helpful. Tricky minerals, they may occur together or as a mixture.

Tennantite was originally found in Cornwall, England. It occurs in hydrothermal veins and contact metamorphic deposits. Hydrothermal veins form when hot fluids pulse through the surrounding older rock. Metamorphic deposits occur when hot fluids or igneous rock *contacts* the older surrounding rock and interacts with it chemically.

You may have deduced that tennantite is an ore mineral mined for copper. The silver, if in the ore, may be the primary product or byproduct of the mining.

In the United States, tennantite is well known from the mines of Butte, MT, along with its analog, tetrahedrite. Nice crystals also come from the Julcani and Quiruvilca mines in Peru and from the Cobre Mine in Zacatecas, Mexico.

Tennantite also occurs in many other copper deposits around the world. Some of these, like Tsumeb, Namibia, though mined for copper, are also noted for minerals. The Swiss use the name "binnite" for tetrahedrite from the Lengenbach dolomite quarry in the Binn Valley near Wallis, Switzerland. This quarry has many unusual sulfosalts. More commonly, tennantite



Tennantite, Tsumeb Mine, Otjikoto Region, Namibia.  
Source: Wikipedia; photo: Didier Descouens.

is found with pyrite, arsenopyrite, chalcopyrite, sphalerite, siderite, barite, quartz, calcite, and dolomite.

As a copper ore, the arsenic in tennantite makes the resulting metal alloy harder. Early civilizations may have exploited this property in creating bronze. ↗

### Technical Details

Chemical formula.....	$\text{Cu}_6[\text{Cu}_4(\text{Fe},\text{Zn})_2]\text{As}_4\text{S}_{13}$
Crystal form .....	Isometric (cubic)
Hardness .....	3.5–4
Density .....	4.6–4.7 g/cm <sup>3</sup> (measured)
Color.....	Dark gray to black, usually opaque, though can be deep red in strong light
Streak.....	Reddish gray
Cleavage.....	None
Fracture .....	Subconchoidal to uneven
Luster.....	Metallic, though often oxidized coating

### Sources

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- Webmineral. N.d. [Tennantite mineral data](#).
- Wikipedia. 2016. [Tennantite](#).



## Titanite

by Sue Marcus

Source: *The Mineral Newsletter*, April 2017.

**T**itanite was named for a principal component, titanium. Although recognized in 1787 as a new—or at least unknown—mineral, it was not formally described and named until 1795.

Most minerals have a type locality, a place where the material that was initially described (the “type”) was first found. Mindat lists three co-type localities for titanite: Hauzenberg, Bavaria, Germany; Philipstown Township, Putnam County, New York; and Rossie, St. Lawrence County, New York. The Putnam County locality is the source of a red-brown variety of titanite known as lederite.

I grew up with specimens of sphene in my mineral collection. This mineral name was introduced by the famous mineralogist and crystallographer René Just Haüy in 1809. Sphene is now a discredited name for titanite, a decision made by the International Mineralogical Association in 1982, so those of us of a certain age may date our labels by the names they show for our specimens. Similar changes have occurred for the names of countries, so cataloguing and labeling minerals can be an ongoing exercise.

Titanite is an unusual mineral in that it commonly forms twinned crystals. I like the galleries.com/sphene description of the twins as “shaped like a deflated, caved-in football, only with flatter surfaces.”



*Titanite. Photo: Bob Cooke.*

Brazil is noted for light-green twinned crystals up to several centimeters in size, with broad flat sides and a sharp V along the twinned plane along the center. Austria and Switzerland also produce olive green to yellow-green crystals. Gem-quality green titanite from the pegmatites of Pakistan has come on the market more recently. Emerald-green crystals are reported from the Ural Mountains of Russia, along with more mundane brown specimens. Italy produces titanite in unusual colors, like yellow-orange and blue. Morocco and Madagascar are sources of green and brown crystals. Ontario is a primary producer of red-brown specimens, sometimes with large crystals.

Chromium can give titanite its green color, whereas traces of manganese create pink or red specimens. According to Gemdat.org, titanite is trichroic, meaning that its color may change in each of the three crystal axes. Some titanite contains traces of thorium in the crystal structure. The thorium makes the titanite slightly radioactive, and it can also make it degenerate or become metamict, with the crystal faces growing slightly rounded.



*Titanite crystals on amphibole, Ochtendung, Eifel, Germany.*  
Source: Wikipedia; photo: Fred Kruijen.

Titanite occurs in all rock types—sedimentary, igneous, and metamorphic—but it is most commonly found in metamorphic rocks. Pegmatites probably host the most aesthetic specimens because they allow the slow growth that leads to the formation of euhedral crystals (showing all crystal faces).

The main ores of titanium, used as a metal for alloys or as titanium oxide for whiteners, are rutile and ilmenite. Titanite itself is not a useful ore mineral.

### Technical Details

Chemical formula ..... $\text{CaTiSiO}_5$   
Crystal form.....Monoclinic  
Hardness .....5–5.5 (Mindat)  
Density..... $3.48\text{--}3.6\text{ g/cm}^3$  (measured)  
Color.....Green, yellow, red, mauve, brown, black  
Streak:.....White to slightly reddish  
Cleavage .....Perfect in one direction  
Fracture.....Subconchoidal  
Luster.....Adamantine, resinous  
Fluorescence .....May have weak brown short-wave fluorescence ↗

### Sources

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*Titanite twin. Photo: Bob Cooke.*

## Topaz

by Sue Marcus

Source: *The Mineral Newsletter*, May 2018.

Our segue from the April to the May Mineral of the Month comes through an isle in the Red Sea called Topasios Island. You might guess from that name alone that the May mineral is topaz.

And I hope you recall that the April mineral, olivine (or peridot), was found on an Egyptian island in the Red Sea. Ancient lapidaries and naturalists apparently used the name “topaz” for peridot!

The island of Topasios (also known as St. John’s or Zabargad Island) eventually gave its name to topaz, although the mineral topaz is not and has never been found there. Even earlier origins of the word “topaz” can be found in Sanskrit or Greek, depending on your preferred source.

### The Color of Topaz

The topaz on the right is a good representation of the mineral’s natural orange color. Topaz can also be clear, light blue, or the color of champagne.

So what about those gorgeous vibrant blue gems we see in stores and at shows? *Caveat emptor*—buyer beware! Enjoy these beauties, but they are almost certainly irradiated and then probably heat-treated to produce that deep blue color.

Some members of our club enjoyed a recent presentation on blue minerals by Dr. Jeffrey Post at the Smithsonian National Museum of Natural History. Dr. Post



Topaz from Minas Gerais, Brazil.  
Smithsonian Mineral Gallery; photo: Chip Clark.

informed us that topaz is irradiated to become the deeper (and more valuable) blue, then heated to remove brown shades that detract from the visual splendor. Many gemstones are treated onsite at the mine itself.

The Smithsonian’s gem collection—notably its topaz specimens—provides valuable research materials because many specimens were acquired prior to the use of color-enhancing techniques. They provide a baseline of natural materials for comparison with more recently extracted, cut, or studied materials.

Pink and orange topaz are colored by traces of chromium in the crystal lattice. Brown topaz can be heat-treated to enhance the color, turning it into shades of pink, a process known as “pinking.” Colorless or pale-hued topaz is also irradiated and heat-treated to enhance the value of the stones. Topaz also occurs in natural red or pale green shades, but only rarely.



Topaz from the Erongo region of Namibia.  
Photo: Bob Cooke.

Some special types (not true varieties) have acquired trade names to help market them. “Imperial topaz” is probably the best known of these special types. The definition of imperial topaz varies with the source and sometimes even within the source. Generally, imperial topaz is supposed to be, as one source described it, “the color of the setting sun”—yellow-gold with hints of red, orange, or violet. Since imperial topaz commands a premium price, the definition has been broadened to include other colors in the yellow-to-pink spectrum (the more material available, the greater the profit).

“Mystic topaz” has been artificially treated to have rainbow hues on the surface. Some relatively bright-colored topaz may fade with exposure to daylight. Check your topaz under long-wave ultraviolet light because some specimens fluoresce yellow to orange.

### Occurrence

Topaz has been known since antiquity to many cultures and occurs worldwide. It is usually found in igneous rocks that are high in silica, like granite and peg-

matite (intrusive) and rhyolite (extrusive). Crystals form in vugs in granite or in rhyolite cavities left by gases. Thus, topaz forms later in the mineralization process than most of the minerals around it.

Brazilian pegmatites are the source of most topaz, particularly imperial topaz, although Russia is another imperial topaz source. To see immense Brazilian topaz crystals, including a natural blue topaz encrusted with lepidolite, visit the Smithsonian’s Natural History Museum.

“Killiecrankie diamonds” was the term given to usually yellow, clear, or blue topaz—often waterworn—found around Flinders Island, Tasmania. Passed off as diamonds in Europe in the 1800s, some of them might still be there. Even earlier, a 1,680-carat topaz known as the Braganza was thought to be a diamond in the Portuguese crown.

Naturally pink topaz is most frequently found in Pakistan. The Erongo Mountains of Namibia are a more recent source of gemmy topaz crystals. Pyknite is a fine-



*The Smithsonian gem hall has topaz crystals in various shapes and hues. The colors are all natural. Photo: Chip Clark.*

Many of us know the famous photograph of two immense Brazilian topaz crystals, weighing 70 pounds and 113 pounds respectively, with a child between them for scale. At the front of the image is the “American Golden Topaz,” weighing 22,892.5 carats. The faceted gem is 6.9 by 5.9 by 3.7 inches in size! Too big to wear; too delicate for a doorstep—you don’t really want it! These and other topaz specimens, cut and uncut, are on display at the Smithsonian’s National Museum of Natural History for all of us to enjoy. Source: Smithsonian Mineral Gallery; photo: Chip Clark.



grained form of topaz, with most Mindat photos from Germany and the Czech Republic, although some are from the McGuire Mine in Colorado.

In the United States, Utah’s Thomas Range in Juab County is internationally known for beautiful, often perfect, “sherry-colored” (yellow to slightly pink) topaz crystals, sometimes in their rhyolite matrix and sometimes having popped out. These crystals are seldom large, although they are beautiful little gem specimens and every collector should have one from this still-producing classic American locality.

I’ve read several descriptions of “wine-colored topaz.” Wine comes in colors ranging from white through pink



Topaz with bixbyite from Juab County, Utah.  
Photo: Bob Cooke.

to red and deep purple, so I find this particular descriptor not descriptive!

### Uses

The primary use for topaz is as a gemstone. Topaz is very hard and therefore durable, but perfect cleavage makes cut gemstones prone to breaking if not handled carefully when cutting or wearing. The physical property of perfect cleavage also results in two specimens for the price of one—when a crystal on matrix becomes detached (breaks) because the piece is mishandled. This property also helps to render some of the Utah crystals as loose rather than matrix specimens, although some loose crystals were simply poorly attached when they grew.

Topaz is usually faceted, although it may be carved or formed into cabochons. Orange topaz is the November birthstone and the state mineral of Utah. Blue topaz is the state gemstone of Texas. Although Texas is not a major topaz producer, it has several pay-to-collect sites awaiting the public. ↗

### Technical Details

(The source is mostly Mindat.)

Chemical formula.....  $Al_2(SiO_4)(F,OH)_2$

Crystal form ..... Orthorhombic

Hardness ..... 8

Density ..... 3.4–3.6 g/cm<sup>3</sup> (measured)

Color.....Yellow, light blue, colorless, pink, brown, rarely red or pale green; often, colorless and brown topaz is heat-treated, as are other pale colored hues, to enhance them  
Streak.....White  
Cleavage.....One perfect cleavage  
Fracture.....Uneven to subconchoidal  
Luster.....Vitreous

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*Red topaz with hyalite, Tepetate, Municipio de Villa de Arriaga, San Luis Potosí, Mexico.  
Source: Wikipedia; photo: Rob Lavinsky.*

## Vanadinite

by Sue Marcus

Source: *The Mineral Newsletter*, February 2016.

Vanadinite is a showy mineral—just look!

Vanadinite was first reported in Mexico by Professor A.M. del Río in 1801 even before the element vanadium had been discovered. Professor del Río taught chemistry and mineralogy at the School of Mines of Mexico in Zimapán. He tested the new mineral and revealed that it contained an apparently new element that came in different colors, so he named the element panchromo (or panchromium, meaning many colors).

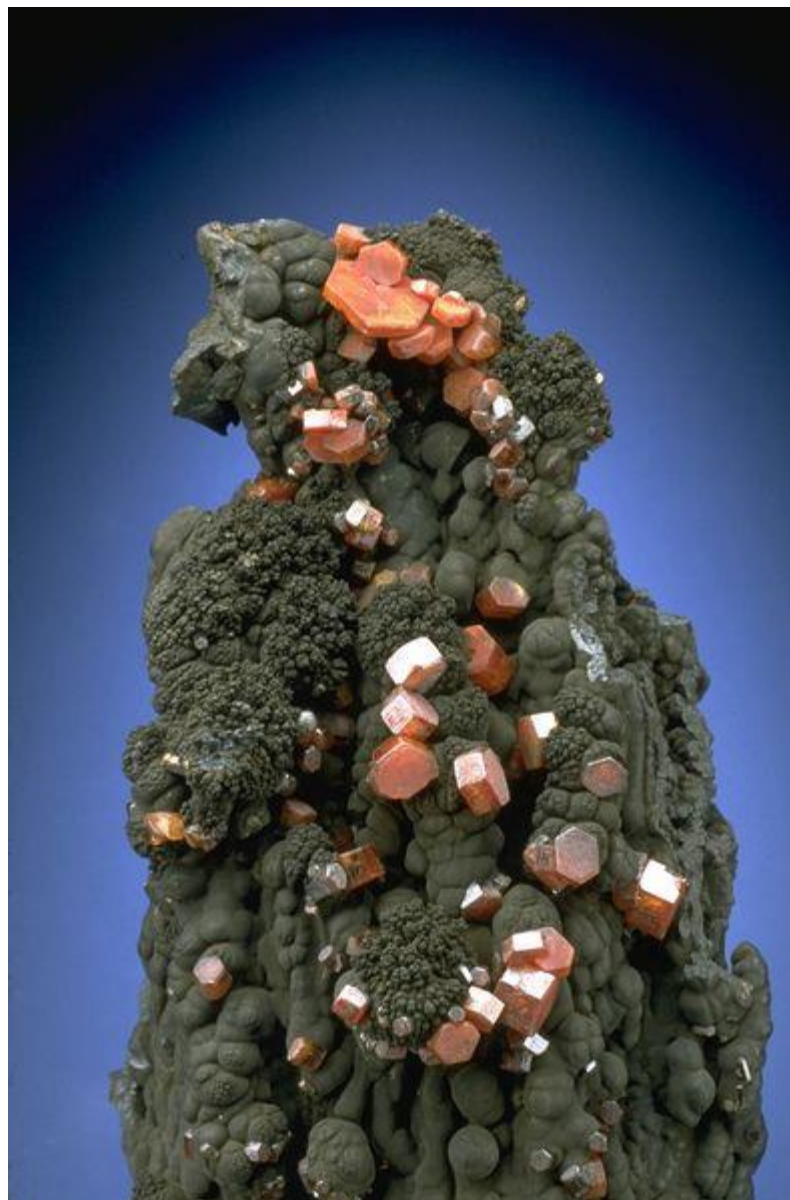
Del Río later changed the name to eritrono (or erythronium, after the Greek word for red). Unfortunately, a French chemist incorrectly discredited del Río's discovery, purporting that the element we now know as vanadium was impure chromium. This went unchallenged.

In 1830, a Swedish scientist isolated what became vanadium from Swedish iron ore and named it after the Scandinavian goddess of beauty, Vanadis (better known in Norse mythology as Freya, whose "day of the week" we now know as Friday).

The type locality where vanadinite was first found is Zimapán, Municipalidad de (municipality of) Zimapán, Hidalgo, Mexico (Hidalgo is a state in the central part of the country). Some of us have Mexican specimens in our collections. More recently, Morocco has become the source of the world's finest vanadinite specimens (see the cover).

Chemically, vanadinite ( $\text{Pb}_5[\text{VO}_4]_3\text{Cl}$ ) forms a solid solution series with mimetite ( $\text{Pb}_5[\text{AsO}_4]_3\text{Cl}$ ) and less often with pyromorphite ( $\text{Pb}_5[\text{PO}_4]_3\text{Cl}$ ). All of these minerals are members of the apatite group. Vanadinite is commonly found with other lead minerals, or molybdates, such as anglesite, cerussite, wulfenite, and mottramite, as well as with mimetite and pyromorphite.

Have you found vanadinite? It is reported from Moss Mine, Tabscott, Goochland County, VA, although this is an obscure locality, at least for vanadinite. Several locations in Arizona are better known, like the Red Cloud Mine (famous for wulfenite) and the Apache Mine. Vanadinite is even reported from the U.S. Army



Vanadinite with romanechite, from Taouz, Morocco.  
Source: Smithsonian Mineral Collection; photo: Chip Clark.

Proving Grounds in La Paz County, AZ (limited collecting opportunities anticipated!).

The flashiest, most spectacular specimens of vanadinite have been mined in Morocco. *The Mineral Record* produced several full-color editions on the Moroccan mines, some featuring vanadinite and others featuring sites where vanadinite is found with other stellar minerals. The Moroccan vanadinites are unusually attractive because perfect orange-red vanadinite crystals are sprinkled on a matrix of white barite crystals (as on the next page) or on black manganese oxides (such as the



*Vanadinite, Mibladen Mine, Mibladen, Auoli, Upper Moulouya Lead District, Midelt, Khenifra Province, Morocco.  
Source: Wikipedia; photo: Parent Géry.*

romanechite on the cover); either condition shows a superb color contrast. You can buy specimens for relatively small sums (\$15), although you can also pay as much as you want for specimens of great size or with large, perfect crystals.

Vanadium, the economically important material in vanadinite, is combined with titanium in aerospace engines. It is also combined with gallium to make superconducting magnets. In addition, vanadium pentoxide is used in ceramics and in producing sulfuric acid.

Most vanadium is a byproduct or coproduct from titaniumiferous sands, phosphate mines, and other geologic sources. Recycled materials and foreign sources meet most U.S. needs.

### Technical Details

Crystal form..... Hexagonal  
Hardness ..... 2.5–3

Density .....6.88 g/cm<sup>3</sup> (measured); 6.95 g/cm<sup>3</sup> (calculated)  
Color.....Brown, red, orange, yellow; less frequently pale yellow, white, or colorless  
Streak.....White to light yellow  
Cleavage.....None  
Fracture .....Irregular  
Luster.....Resinous, subadamantine ↗

### Sources

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## Wulfenite

by Sue Marcus

Source: *The Mineral Newsletter*, February 2017.

Wulfenite is an eye-popping mineral (as you can tell from the photo on the right). It is found in exquisite crystals and colors. It is a welcome addition to most mineral collections.

Although some collectors pay tens of thousands of dollars for a single wulfenite specimen, the rest of us can afford lovely smaller pieces to grace our collections. Wulfenite specimens may also be purchased at our mineral club auctions. That's where I obtained my favorite wulfenite.

Collectors should be grateful that wulfenite was renamed. In 1772, it was originally called “plumbum spatosum flavo-rubrum, ex Annaberg, Austria.” In 1781, it acquired the German name *kärnthnerischer Bleispath*, which translates roughly as “lead spar from Carinthia” (in Austria). (The term *Spat*—as in *Feldspat*, or feldspar—connotes perfect cleavage.)

Other names were also used before the name it was given in 1845 finally stuck. Wulfenite was named for a Jesuit, Franz Xavier von Wulfen, who authored a monograph on the lead ores of Bleiberg, Austria. The mineral (of whatever name) was apparently first reported from Austria.

Wulfenite is often associated with other lead minerals or with vanadium or zinc minerals like vanadinite, smithsonite, mimetite, and galena. Tungsten can substitute for molybdenum atoms so that wulfenite forms a solid solution series with stolzite; that is, the minerals form a chemical spectrum from containing only molybdenum (wulfenite) to containing only tungsten (stolzite).

Wulfenite occurs as a secondary mineral in deposits rich in lead and molybdenum oxide. The deposits are left by water and other fluids leaching materials from the host rock or as hydrothermal fluids percolating upward through the rock. Host rocks in Austria are carbonates (limestones and dolomites). In Arizona, altered igneous rocks are the hosts.

Crystals of wulfenite appear to be tabular. They are more beautiful when they are transparent or translucent, perched on the host rock, showing off (like the specimen above).



Wulfenite from the Red Cloud Mine, Arizona.

Source: Smithsonian Mineral Gallery; photo: Dana Penland.

Thicker, opaque, tabular orange crystals are more common, such as those from Sierra de Los Lamentos, Chihuahua, Mexico (see the specimen below). Wulfenite can be used as an ore—economic source—of molybdenum, so many stunning specimens have probably gone to the crushers.

Red Cloud, AZ, is a world-famous locality for exceptional wulfenite specimens. Wulfenite is also found at other sites in Arizona. Mexico also has several noted wulfenite localities.



Wulfenite from the Ahumada Mine, Sierra de Los Lamentos, Chihuahua, Mexico.

Source: Smithsonian Mineral Gallery; photo: Chip Clark.

China and Iran are relatively recent specimen producers, while Congo, Morocco, and Namibia are also well-known localities for specimens. The old locality of Bleiberg, Austria, though not an active mine site, is still treasured for lovely historic specimens.

Most wulfenite specimens are not fluorescent, although some specimens from Arizona are reported to fluoresce under short-wave ultraviolet light, probably with uranium as an activator. Long-wave fluorescence is also reported, although without specific details about where the specimens came from, along with confirming photographs.

Though attractive, wulfenite is far too brittle, fragile, and soft for jewelry. Still, it has been faceted or used in jewelry as a novelty. ↗

### Technical Details

Chemical formula ..... $\text{PbMoO}_4$   
Crystal form.....tetragonal  
Hardness .....2.5–3  
Density .....6.5–7.0,  $\text{g/cm}^3$  (measured)  
(depending on source)  
Color: .....usually orange but can range  
from yellow to orange-red and brown  
Streak .....white  
Cleavage .....perfect in one direction  
Fracture .....conchoidal to uneven  
Luster.....resinous, adamantine, vitreous  
(sources vary)

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*Rosette arrangement of wulfenite from the Xinjiang Uyghur Region, China. Source: Wikipedia; photo: Rob Lavinsky.*

## Zincite

by Sue Marcus

Zincite is synonymous with Franklin, NJ, as exemplified by the lovely crystal on the right. But if you think this mineral is always red, look at the brownish-green synthetic crystal below.

The chemical formula of zincite is zinc oxide ( $\text{ZnO}$ ), but iron and manganese (Fe and Mn, respectively) are usually significant components of the mineral material. The red color comes from traces of iron and manganese in the crystal structure. That's why the purer synthetic material does not have that feature.

Although Archibald Bruce originally identified the mineral as zinc oxide in 1810, it did not receive the name “zincite” until Wilhelm Karl von Haidinger bestowed the moniker in 1845. Minerals usually retain the earliest name published for them, but for unknown reasons zincite was called “sterlingite” by Francis Alger in 1944. Another name, used by Henry James Brooke and William Hallows Miller, was “spartalite.”

Today, the International Mineralogical Association (IMA) officially sanctions mineral names, usually following publication of a physical and chemical description in a peer-reviewed journal. Zincite, the name for zinc oxide, was grandfathered into the IMA list of minerals.

The major occurrences of zincite are Franklin and Sterling Hill in New Jersey. Natural zincite is also found in slag heaps from mines in Poland, a country that also produces synthetic zincite. Mindat notes that synthetic



*Zincite from New Jersey.*

*Source: Smithsonian Mineral Gallery; photo: Dana Penland.*

zincite crystals are commonly available for sale, although I personally have not seen them.

The Mindat photos of zincite show natural specimens from New Jersey, with one very odd exception: tiny (less than 1-mm) crystals from an arsenic-rich fumerole—an igneous source—in western Russia.

Zincite has yielded faceted gemstones, usually from synthetic material. Natural specimens are usually too fractured, opaque, or both to make attractive cut stones.

With the odd and unexplained exception of the Russian fumerole, zincite forms in metamorphic rocks that are rich in zinc, iron, and manganese. Though zincite is rarely fluorescent, Mindat reports that at least some yellow zincite from the Sterling Mine fluoresces yellow-green under short-wave ultraviolet light.

Zincite commonly occurs as small patches of red—rather like dark blood stains—in the Franklin marble, although it may occur as cleaved or scaly masses up to several inches in diameter. Crystals are rare, and well-formed crystals showing many faces (like the one above) are very rare. In the Franklin–Sterling Hill deposits, zincite adds color to the black franklinite, white calcite, and beige-to-brown willemite. Dark red massive specimens may look like works of art, with swirls or sharp lines of zincite crossing the white marble.



*Synthetic zincite. Source: Wikipedia.*

Zinc, the metal, is used as a protective coating for other metals, for example galvanized pails. It is used in chemicals and medicines and is alloyed with copper to make brass. The Franklin–Sterling Hill zincite deposits are the only ones ever known to have been mined for zinc; willemite and franklinite also provided zinc ore from these mines. Zincite is not found in sufficient quantities to be ore grade elsewhere.

### Technical Details

Chemical formula ....ZnO  
Crystal form .....hexagonal  
Hardness .....4  
Density .....5.64-5.68 g/cm<sup>3</sup> (measured)  
Color .....usually deep or dark red, to slightly purplish red  
Streak .....yellowish-orange  
Cleavage .....one good cleavage, one fair parting  
Fracture .....conchoidal  
Luster .....resinous to subadamantine

*An interesting note from Wikipedia:*

Both natural and synthetic zincite crystals are significant for their early use as semiconductor crystal detectors in the early development of crystal radios before the advent of vacuum tubes. As an early radio detector, zincite was used in conjunction with another mineral, galena, and this device was known as the cat's-whisker detector. ↗

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*Zincite crystals on matrix, Arizona. Source: Wikipedia.*