



EARTHQUAKE

e-Newsletter about what's movin' and shakin' at the Earth Science Museum

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ESM OUTREACH UPDATE

Mardy Zimmermann Outreach Coordinator

Part II

“What was the Arizona Mining and Mineral Museum?”

As reported last month, on November 18th, Shirley Cote, ESM Board member, gave a presentation to the Maricopa Lapidary Society (MLS) on “What was the Arizona Mining and Mineral Museum?” As some of you may know, the Museum was closed abruptly at the end of April 2011.

The following is an amended version of *Talent Unearthed* by Liz Anderson from the Friends of the AZ Mining and Mineral Museum Newsletter in 2004 with photos from Shirley’s presentation.

And to think it all started with one of the Seven Dwarves and some pieces of travertine Shirley Cote had meticulously learned to cut, polish, and inlay!

Shirley, a long-time member of Maricopa Lapidary Society (MLS), started off as a volunteer with the AZ Mining and Mineral Museum (AMMM) on the first Saturday in October 1991. She was hired as an official Tour Guide in January 1998, but still volunteered a great deal of time to the museum. Her official duties included but were not limited to tour guide duties, school classes, the very popular Scout Badge Program she developed, gift shop sales, specimen inventory, learning the labyrinth of computer technology, and often mentoring

new Tour Guides with patience and humor. Her organizational skills were legendary and much appreciated. Being able to bring order from chaos makes it easier to accomplish the Museum’s goals.

“Happy”, by the way, is the Dwarf that started it all. He was part of the showcase - *Happy’s Travertine Cabin* - for the MLS Phoenix Gem and Mineral Show and at the State Fair in 1994. That experience demonstrated to Shirley she has a talent for creating displays. And, much to hubby Doug Duffy’s delight, she has developed that talent in an awesome manner over the years.



She expanded her display in 2002 by using colorful fabric, and purchasing miniature



items like a hand water pump and barrel of “water”, little critters, trees, etc. For the inside of the cabin, she made a travertine bed, table and chairs, and a bookshelf and added miniature books, a mirror, wood stove, coffee pot and dishware.

If you wandered through the museum, you could see her various exhibits, the MLS and State Fair Exhibits, that Susan Celestian asked her to put on permanent display. Visitors enjoyed *The Rock Cycle*, *Periodic Table of Elements*, *Uses of Elements for Products*. One of the most popular of her exhibits that visitors asked about and was at the MLS Phoenix Gem and Mineral Show and that took a blue ribbon at the State Fair: *The Solar System as Mineral Spheres* created with spheres from the museum’s collection.



Her newest accomplishments were two incredible showcases on the north side of the stairs. *Crystal Systems* clearly shows the crystal growth habits of minerals using models, color coding, and actual samples. The second case invites the museum visitor

to go on a light-hearted *Crystal Habits Challenge* with the knowledge gained from the adjacent showcase. It was a journey of discovery for those who are involved with minerals and their formation. Those who took the challenge included occasional youngsters, serious rockhounds, geologists, employees, and repeat visitors who often remarked they learned something new “this time around again”. One of the first to experience the showcases was the superintendent of an Arizona state park. He remarked that it was the most fun he had experienced with his avocation in years.



Shirley’s Crystal Systems display at the MLS 2003 Phoenix Gem and Mineral Show.



Crystal Systems display at the AZ Mining and Mineral Museum.



Crystal Habits display at the AZ Mining and Mineral Museum.

How did the New Hampshire native with an eye for detail arrive at this moment in her professional life? The answers are complex, but briefly, she has inherent curiosity about our Earth and the forces that shape it. Shirley's philosophy is encouraging people to delve deeper. Over the years she has felt profound satisfaction from being able to research information and then meticulously abstract that information. She takes pleasure in utilizing her research in a multi-level and multi-dimensional fashion, and will not hesitate to use different approaches with each new project. It takes an enormous amount of tough work to do and redo the exhibits until Shirley is pleased with the results. It was hoped that her extremely witty *Polar Exhibit* from this year's 2004 MLS Show would be on display sometime soon.

The *Polar Exhibit* was multi-level and multi-dimensional. The left side showed an ice flow with polar bears, seals and a fishing wharf. Under the ice flow showed an articulated humpback whale, sharks, fish, starfish and other sea creatures.



The right side showed a fishing village on an arctic winter night sitting atop a granite deposit.



There was a myriad of other displays Shirley created including a waterless aquarium and a chalcedony garden pictured below.



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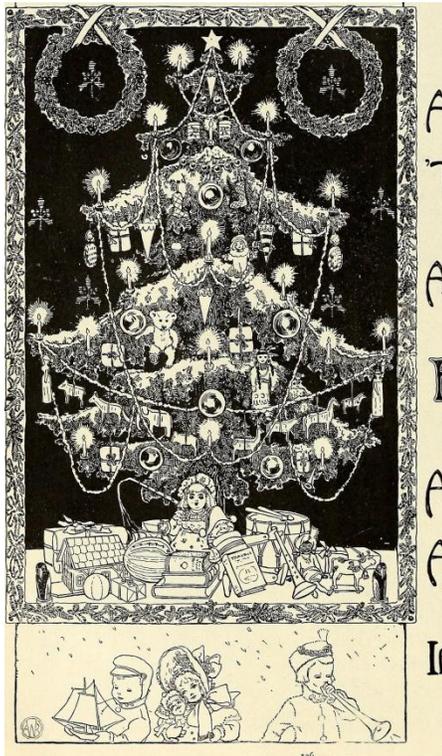
Christmas Light Minerals

By Harvey Jong

It's Christmas time again which means it's time for another Christmas-themed article. Last year, we focused on minerals with shapes that resembled a Christmas tree. This article will explore the minerals used in producing different types of Christmas lights.

Some Background on Christmas Lights

We'll start with some of the history and technology behind Christmas lights. The tradition is tied to the decoration of Christmas trees that was started by Lutheran Christians around the 16th century. Trees were adorned with candles which symbolized Jesus as the Light of the World. The candles, however, were relatively expensive and attached with pins or melted wax which represented a major fire hazard.



Christmas Tree With Small Candles

Illustration from 1873 children's book *St. Nicholas* by Mary Mapes Dodge (1830-1905), - Flickr API, via Wikimedia Commons

Electric lights were introduced in 1882 by Edward Johnson (1846-1917), an associate of Thomas Edison (1847-1931). He strung 80 hand-wired red, white, and blue bulbs around a tree that rotated on a platform. As planned, the novelty of the dazzling tree display attracted attention, and Edison's General Electric Company started marketing electric lighting outfits in 1903. The kits included 28 one-candle power, carbon filament lamps, but the price was \$12 which would be more than \$300 in today's dollars. So, the lights were made available for rent. Another hurdle involved the relatively limited availability of electric service.

ELECTRIC LIGHTING OUTFIT



For
Christmas Tree
and House
Decoration

*Completely
made up
and ready for
use*

Retail price for complete outfit, including 28 one-candle power miniature Edison lamps, neatly packed in handsome box, \$12.00. Liberal discounts to the trade.

MAIN SALES OFFICES

Edison General Electric Company

Harrison, N. J.

Early Ad for Christmas Lights

- PD, via christmasdesigners.com

Around the 1900s, the average worker's salary was about 22 cents per hour, so the \$12 price tag limited the lighting kits to the wealthy and businesses.

The cost and reliability of the lights improved as demand started to increase. In 1919, General Electric released flame-shaped bulbs that used tungsten filaments

from its line of Mazda lamps. (Note that Mazda was a G.E. trademark name based on Persian mythology's god of light, Ahura Mazda.)



A 1920s General Electric Ad for Mazda Christmas Lamps

- PD, via christmasdesigner.com

The next innovation in Christmas lights involved the development of the Light Emitting Diode (LED). The first red LED was invented in 1962 by Nick Holonyack, Jr. (1928-2022), a consulting engineer for General Electric. He built the diode using the compound semiconductor, gallium arsenide phosphide (GaAsP). Zinc and tin impurities were added to modify the material to have either an excess of electrons (called n-type) or a deficiency of electrons (p-type). When an electric current is applied, the electrons from an n-type layer combine with the absence of electrons or “holes” in a p-type layer which causes photons to be released producing visible light.

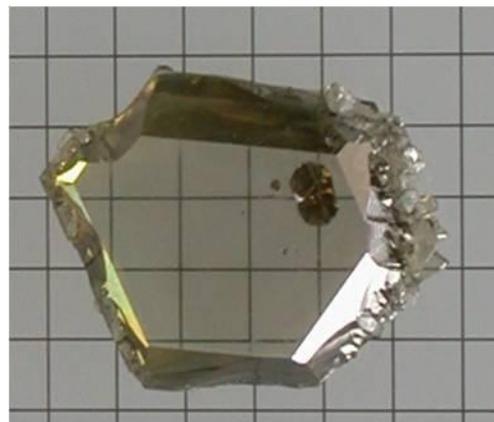


Evan Amos photo, - PD, via Wikimedia Commons

Low-cost red LEDs became available around 1968, and initial applications included numeric displays in calculators and digital watches.

Subsequent research on new semiconductor materials yielded LEDs that emit different colors and with greater brightness. A green LED was demonstrated in 1972, and bright green LEDs based on gallium phosphide (GaP) were produced in 1993.

The blue LED, however, represented a major technical challenge since it required producing high-energy photons. The energy of emitted photons is determined by a property of a semiconductor known as the bandgap. A wide bandgap [around 2.6-3.0 electron volts (eV)] is needed, but this is beyond compound semiconductors, such as GaAs (1.424 eV) and GaP (2.24 eV). Gallium nitride (GaN, 3.4 eV) subsequently emerged as the key material for blue LEDs.

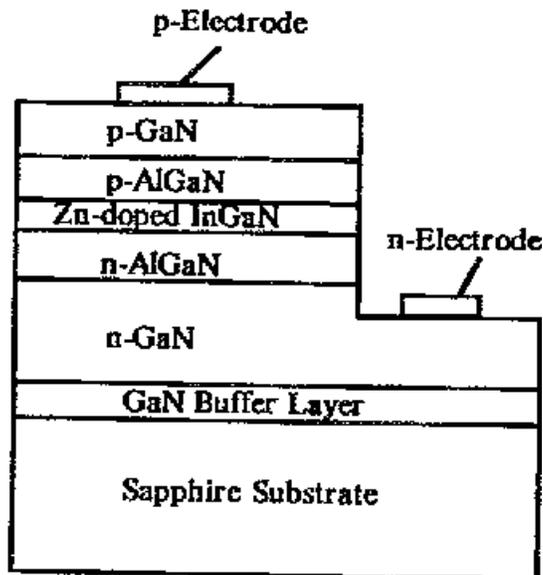


Gallium Nitride Crystal

Opto-p photo, - PD, via Wikimedia Commons

In 1972, RCA researchers created a prototype blue LED by combining GaN layers doped with magnesium and silicon impurities. The device, however, was dim due to the difficulty in producing a p-type layer of GaN. The development project was

subsequently cancelled. It wasn't until 1994 when a breakthrough in producing layers of indium gallium nitride (InGaN) and aluminum gallium nitride (AlGaN) in a new diode structure resulted in the first high-brightness blue LED. Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura, who invented this blue LED, were awarded the 2014 Noble Prize for Physics.



Structure of a Blue LED

Figure 1 from (Nakamura et al., 1994)

This diagram depicts the stack of compound semiconductor layers that make up a blue LED. The crystalline layers are carefully grown on sapphire base using a process known as metalorganic chemical vapor deposition.

The central zinc-doped InGaN layer, which is about 20 nm thick, represents the active layer where photons are emitted. When a voltage is applied to the LED, electrons are injected into this layer by the n-AlGaN layer below and confined by the holes of the p-AlGaN layer above. Photons are produced when these electrons combine with the holes of the InGaN layer. The surrounding p- and n-type GaN layers further confine the electrons and photons. The GaN buffer layer helps limit the effects of crystal defects resulting from the lattice mismatch between

the sapphire and compound semiconductor (Nakamura et al., 1994).

Development of a bright blue LED enabled two additional types of very popular LEDs: RGB LEDs and white LEDs. As its name suggests, the RGB LED combines red, green, and blue LEDs in a single unit. By adjusting either, the output or switching rate of the LEDs, a wide range of colors, including white, can be produced. The resulting white color, however, may be limited in accuracy or brightness, while the cost of the RGB LEDs is higher than that of a single diode device.



RGB LED Module

Mister RF photo, - CC_BY-SA-4.0 International, via Wikimedia Commons

This module, which is named the 5050 for the three 5.0 mm x 5.0 mm LED chips, is used in many programmable LED strips.

Like fluorescent lights, white LEDs use phosphors to convert the output of a blue LED into a broad-spectrum light. A combination of different phosphors, such as cerium-activated yttrium aluminum garnet, europium-activated barium strontium silicate, or europium-activated silicon nitride, may be combined depending upon the desired color temperature (cool vs warm white light).



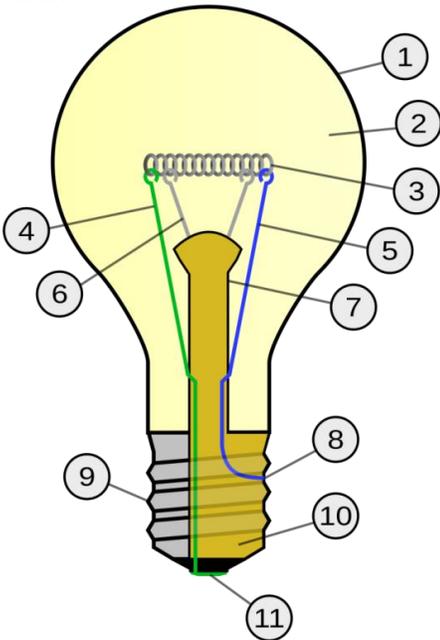
A White LED Light Bulb and Its Internal Components

©Raimond Spekking photos, - CC_BY_SA-4.0, via Wikimedia Commons

The six yellow dots are white LED chips made up of blue LEDs covered by a yellow coating of a cerium-activated yttrium aluminum garnet (YAG-Ce³⁺) phosphor.

Old School Christmas Lights: Incandescent Bulbs

Starting with an incandescent bulb, we will now discuss the different parts of a bulb and the minerals that are needed to produce them.



Parts of an Incandescent Light Bulb
Clipart illustration, via pikpng.com

| Incandescent Light Bulb Parts and Associated Elements | | |
|---|---|------------|
| Diagram Number | Part Name: Material | Elements |
| 1, 7 | Glass bulb Glass mount: soda-lime glass | Ca,Na,O,Si |
| 2 | Gas filling: inert gas to extend filament life, extracted from air | Ar,Ni |
| 3 | Filament: tungsten | W |
| 4, 5, 8 | Lead-in (dumet) wires: copper-clad nickel-iron wires | Cu,Fe,Ni |
| 6 | Support wires: molybdenum provides high-temperature, corrosion resistant support of the filament | Mo |
| 9 | Base/cap: designed to fit in standard sockets, made of either brass or aluminum | Al,Cu,Zn |
| 10 | Insulator: vitrite is a slag glass comprised of lead and manganese oxide | Mn,O,Pb |
| 11 | Electrical contact: solder | Pb,Sn |

Incandescent Light Bulb Minerals



Bauxite (Mixture of Aluminum & Iron Hydroxides)

James St. John photo, Minnesota Discovery Center specimen, - CC_BY_SA-2.0, via Wikimedia Commons

Arkansas

Bauxite represents a major source of aluminum and may consists of a mixture of gibbsite $[\text{Al}(\text{OH})_3]$, böhemite $[\gamma\text{-AlO}(\text{OH})]$, or diasporite $[\alpha\text{-AlO}(\text{OH})]$. Aluminum is used in the base/cap of a light bulb.



Calcite (CaCO_3)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Cypress Mine, Bagdad, Yavapai County, Arizona

8.9 x 5.5 x 2.0 cm

Calcite, in the form of limestone, is used in making the soda-lime glass of a light bulb.



Cassiterite (SnO_2)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Viloco Mine, Layoza Province, La Paz Department, Bolivia

8.3 x 7.6 x 6.4 cm

Since ancient times, cassiterite has been the chief source of tin. The electrical connections of a light bulb are soldered with a tin lead alloy with ratios of 60% tin/40% lead or 63% tin/37% lead.



Chalcopyrite (CuFeS_2)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

San Martin Mine, San Martin, Zacatecas, Mexico

2.2 x 1.9 x 1.5 cm

Chalcopyrite is the most abundant copper ore mineral with a copper content of 34.6% by weight. Copper is used in the wires and in a brass base/cap of a light bulb.



Galena (PbS)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Sweetwater Mine, Viburnum Trend District, Reynolds County, Missouri

8.7 x 7.8 x 5.7 cm

Galena is a primary lead ore which occurs in hydrothermal veins or as replacement deposits. Lead is used in the light bulb's solder connections and in making vitrite, an electrical insulator in the base/cap.



Hematite (Fe₂O₃)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Bouse, Plumosa District, Plumosa Mountains, La Paz County, Arizona

2.4 x 1.3 x 1.3 cm

Hematite is a major source of iron. The lead-in wires of a light bulb are made of a dumet (short for dual metal) wire of a nickel-iron alloy. This alloy is designed to have a thermal expansion that matches the bulb's glass which ensures a good metal-to-glass vacuum seal.



Halite (NaCl)

Parent Géry photo, - CC_BY_SA-3.0, via Wikimedia Commons

Trona, San Bernardino County, California

Halite is the natural form of sodium chloride which is combined with limestone to produce soda ash (sodium carbonate). The soda ash serves as a flux in lowering the melting point of silica for making the soda-lime glass of a light bulb.



Molybdenite (MoS₂) on Quartz

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Moly Hill Mine, La Motte, Abitibi-Témiscamingue, Québec, Canada

3.6 x 2.6 x 2.0 cm

Molybdenite is the most common source of molybdenum. Because of its high melting point (-2620°C) and good corrosion resistance, molybdenum is used to support the filament of a light bulb.



Quartz (SiO_2)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Hot Springs, Garland County, Arkansas

7.9 x 6.0 x 4.3 cm

Quartz, in the form of sand, is the source of the silica used in making the soda-lime glass of a light bulb.



Pentlandite ($\text{Ni}_x\text{Fe}_y\text{S}_8$, where $x+y=9$) with Pyrrhotite

Darla Sondrol photo, - CC0-1.0 UPD, via Wikimedia Commons

Near Cobalt, Ontario, Canada

6 cm across

Pentlandite is a major nickel ore that often occurs with the iron sulfide, pyrrhotite. Nickel is alloyed with iron for the lead-in wires of a light bulb.



Pyrolusite (MnO_2)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Donna Ana County, New Mexico

6.5 x 5.6 x 2.3 cm

Pyrolusite is a common manganese ore with a manganese content of 63% by weight. Manganese is used in producing the vitrite that electrically isolates the base/cap of a light bulb.



Sphalerite (ZnS)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Idarado Mine, Telluride, San Miguel County, Colorado

2.3 x 2.3 x 1.2 cm

Sphalerite is the chief ore of zinc. The brass of a light bulb's base/cap is an alloy of zinc and copper.



Wolframite (Ferberite) with Apatite, Arsenopyrite, and Zinnwaldite

Didier Descouens photo, - CC_BY_SA-4.0 International, via Wikimedia Commons

Panasqueira Mines, Panasqueira, Covilhã, Castelo Branco District, Portugal

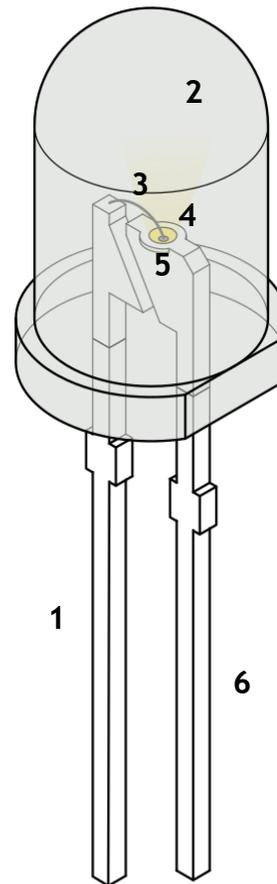
18 x 13 cm

Wolframite is a tungsten ore which is an intermediate member of ferberite and hübnerite tungsten mineral series. Due to its high melting point (3422°C), strength, durability, and visible light emission when heated, tungsten is the primary element used in incandescent light bulb filaments.

Hi-Tech Christmas Lights: LED Lights

Since many LED lights are designed to directly replace incandescent bulbs, they share some of the same structural elements, such as a bulb-shaped enclosure and screw-in base/cap. The key differences involve the use of LED chips and a phosphor instead of a filament and a driver circuit board that converts the voltage to the level required by the LEDs and controls special effects, such as blinking and changing colors.

We will focus on the parts that comprise a white LED.



Parts of a White LED
Inductiveload drawing, - PD, via Wikimedia Commons

| White LED Parts and Associated Elements | | |
|---|---|--------------------|
| Diagram Number | Part Name: Material | Elements |
| 1 | Lead frame-anode: plated copper-iron alloy structure that provides physical support and electrical connection. The anode is the longer lead which is connected to the positive side of a voltage source. | Cu,Fe |
| 2 | Lens/case: made of epoxy | C,H,O |
| 3 | Wire bond: gold wire connects the lead frame with the led chip | Au |
| 4 | Phosphor: cerium-activated yttrium aluminum garnet converts blue light to broad spectrum light | Al,Ce,O,Y |
| 5 | LED chip: InGaN/AlGaIn layers on a sapphire substrate | Al,Ga,In,N Al,O |
| 6 | Lead frame-cathode: plated copper-iron alloy structure that provides physical support and electrical connection. The cathode is the shorter lead which is connected to the negative side of a voltage source. | Cu,Fe |

White LED Minerals



Bastnäsite-(Ce) [Ce(CO₃)F]

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Zagi Mountain, Mulla Ghor, Khyber Agency, Federally Administered Tribal Area, Pakistan

1.5 x 1.5 x 0.3 cm

Bastnäsite-(Ce) is the cerium dominant member of the bastnäsite group of fluorocarbonate minerals. This mineral along with monazite-(Ce) is the main source of cerium, the most abundant of the rare-earth elements. Cerium is added to yttrium aluminum garnet (Y₃Al₅O₁₂) to produce the phosphor for white LEDs. It serves as an activator impurity that absorbs some of the light from a blue LED and re-emits it as yellow light. The combination of blue and yellow light is perceived as white light.



Corundum (var. Sapphire)

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Sri Lanka
1.3 x 0.4 x 0.3 cm

Corundum (var. Sapphire, Al₂O₃)

Sapphire is used as a substrate for LED chips since it is a good electrical insulator with high temperature stability and strength. Wafers may be up to 8 inches in diameter with thicknesses around 1300 to 1500 microns. With LED chips varying from 0.5 mm to 5 mm wide, a single wafer may produce several thousand LEDs.

4.7 x 4.5 x 0.7 cm, 105.6 g

Gold has several properties, such as high electrical conductivity, corrosion resistance, and ductility, that make it the most widely used material in connecting electrical components, such as LEDs. Wires with diameters ranging from 15 to 25 microns are used to connect a LED chip with a lead frame (Abdul Alim, et al., 2021).

Gallium and indium are key elements used in the compound semiconductors of LED chips. A number of minerals have compositions which include these elements (gallium: 9, indium: 17), but their occurrence is rather uncommon. So, the main sources involve by-products from the processing of other commodity minerals, such as bauxite and sphalerite.



Gold

Rob Lavinsky, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Chispa Gulch, Greaterville placer deposits, Greaterville, Santa Rita Mountains, Pima County, Arizona



Sphalerite with Gallium

Pacific Museum of Earth specimen and photo, - CC_BY_SA-2.0, via Wikimedia Commons
Pyrenees, Valle D'argele France



Sphalerite with Germanium and Indium

Pacific Museum of Earth specimen and photo, - CC_BY_SA-2.0, via Wikimedia Commons
Mineral De Los Plomosos, Aldama Chihuahua, Mexico

Xenotime-(Y)

Christian Rewitzer photo, - CC_BY_SA-3.0, via Wikimedia Commons

Mt Malosa, Zomba District, Malawi

Field of view: 3 mm

One source of yttrium is xenotime-(Y), a yttrium phosphate which occurs in granite pegmatites and as placer deposits through the weathering of these pegmatites. Yttrium is used to produce the synthetic garnet, yttrium aluminum garnet (YAG, $Y_3Al_5O_{12}$). This garnet material has been used in a variety of applications including as a gemstone simulant. When cerium (Ce^{3+}) impurities are added, it acts as a phosphor for white LEDs. The cerium ions form luminescent centers that absorb the light of a blue LED and re-emit the energy as yellow light. We perceive the combination of blue and yellow as a white light.

Summary

Hope you have enjoyed this somewhat detailed look into the minerals that are used in producing Christmas lights. Best wishes for a very Merry Christmas or whatever holiday you may be celebrating this season!

References:

Abdul Alim, M., M.A. Abdullah, M.S. Abdul Aziz, and R, Kamarudin (2021) Die

attachment, wire bonding, and encapsulation process in LED packaging: a review. *Sensors and Actuators A Physical* 329: 112817.

Nakamura, S., T. Mukai, and M. Senoh (1994) Candela-class high-brightness InGaN/AlGaIn double-heterostructure blue-light-emitting diodes. *Applied Physical Letters* 64(13): 1687-1689.

**2025 National Christmas Tree**

Andrea Hacks/White House photo, - PD, via Wikimedia Commons

**2012 U.S. Capitol Christmas Tree**

US Capitol photo, - PD, via Wikimedia Commons



Arizona Rocks 151

Text by Ray Grant

I have driven along Price Road just north of Florence many times. It is the road to Country Thunder so don't go in the beginning of April. There are a few mines in the area and it leads to Box Canyon, an interesting place to hike. Where Price Road turns north as Box Canyon Road, I always looked at the interesting rock formation about a half mile to the west and wondered what it was. It is even closer to Price Road before you turn north but is not as spectacular looking.

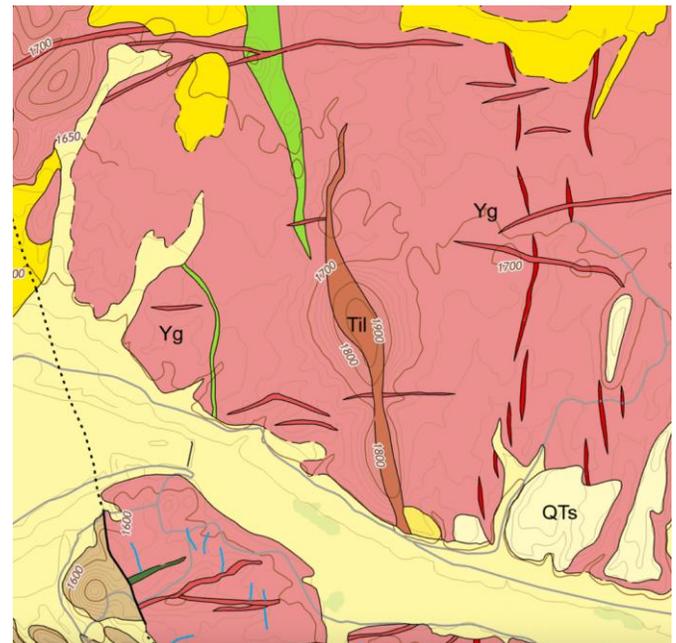
So how do you find out about the rocks you see any place in Arizona. A look at google earth shows it as a long narrow ridge. So, I went to the Arizona Geological Survey website to find a geologic map of the area. It is in the North Butte Quadrangle and there is a geologic map and pamphlet where you can find information about the geology of the area. (Geologic Map of the North Butte Area, Central Arizona v. 2.0, Digital Geologic Map DGM-251, 2024).

The rock I see is a Miocene dike (Til) cutting Precambrian granite (Yg). The dike is composed of reddish-brown felsite with fragments of the granite. The red colored east west dikes on the map (Tkq) are also felsite and some may have large feldspar crystals and are worth checking. I saw a reference to an arch in the dike, but not sure of the location. A walk around this area could be very interesting.

Google Earth photograph of the dike



View of dike from Box Canyon Road
Ray Grant photograph



Geologic Map of dike area, it is the Til, Arizona Geological Survey, Geologic Map of the North Butte Area





351 N. Arizona Blvd., Coolidge, AZ
Pinal Geology and Mineral Society next meeting
January 21, 2026

Meetings are the third Wednesday at 7pm, doors open at 6:00

www.pinalgeologymuseum.org

Ray Grant ray@pinalgeologymuseum.org

Pinal Geology and Mineral Museum
museum open Fridays & Saturdays from 10 - 4
admission is free.

Groups can arrange special visits please call 520-723-3009.

Please join the Pinal Geology and Mineral Society on Wednesday, January 21 at 7pm as we welcome our new State Mine Inspector, Mr. Les Presmyk. Les will talk about his new role and give us updates on current mining projects and what this might mean for the collector.

As usual, our doors will be open at 6pm so stop in early to have a look around and see what is new--we have added new displays and will have new loaned specimens on display!

We will have our usual refreshments, a raffle drawing, a silent auction table and we will provide an update from our booth at the 53 Annual Flagg Gem and Mineral Show in Mesa, Arizona on January 9-11.

After a wonderful Pot Luck on December 21st, members had a fun time playing Rocko a type of Bingo but using rocks.

Rocko is a fun way to help people learn to identify some of the most common basic rock types, including: shale, tuff, sandstone, granodiorite, travertine, quartzite, rhyolite, marble, slate, gneiss, diorite, andesite, limestone, granite, gabbro, and basalt.





AZ Mining, Mineral & Natural Resources Education Museum Update December 2025

<https://ammnre.arizona.edu/>

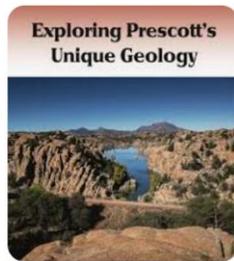
Catie Carter Sandoval

cscarter@email.arizona.edu

703.577.6449

Help support the museum at:

<http://tinyurl.com/SupportMM-NREMuseum>



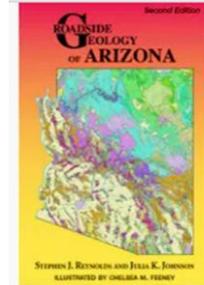
Beth Boyd has just published her book, *Exploring Prescott's Unique Geology*. This is the book we have all been looking forward to seeing, and it lives up to expectations. All your questions about Prescott's geology are finally answered! (Well, certainly most of them.) As a bonus, the book includes "A Geologic Tour of the Courthouse Plaza and Vicinity," by Jim Neal, literally describing the building blocks of Prescott.

The book is available at Peregrine Bookstore, The Lookout, and the Natural History Institute. It is well worth the \$27.95

Beth said these Prescott stores carry it.

- Peregrine bookstore
- The Lookout (formerly Jay's Bird Barn) [1230 Willow Creek Road](#) (between Willow Creek and Gail Gardner Roads)

- Lifeways (on the east side of the square in Prescott)
- Prescott Natural History Institute (on Marina St in Prescott)
- Highland Nature Center, on Walker Road



Also, the release earlier this year of Steve Reynolds and Julia Johnson's new *Roadside Geology of AZ* is available.

<https://mountain-press.com/products/roadside-of-arizona>

Nowhere in the country is the roadside geology better exposed than in the mountains and deserts of Arizona. With this photo-filled book as your guide, you will experience the rocky scenery of Arizona with a new appreciation, as you learn about colorful badlands in the Painted Desert, past environments preserved in Sedona's red and white sandstone cliffs, fossilized logs at Petrified Forest National Park, and the copper mined at Bisbee, Morenci, Bagdad, and elsewhere. Impressive gorges cut through the landscape, including those of the Little Colorado, Gila, and Salt Rivers, but the most spectacular gorge is the Grand Canyon, with its famous layered walls underlain by 1- to 2-billion-year-old rocks. Related ancient rocks are readily observed in parks on the outskirts of Phoenix, Tucson, and Prescott, and in the mountain ranges of central and southern Arizona. From the Colorado River's earliest stream deposits near Yuma to ancient sand dunes preserved in the walls of Canyon de Chelly in the Four Corners region, and from volcanic tuffs near Kingman to silver veins at Tombstone, *Roadside Geology of Arizona* crisscrosses the state to cover all its fascinating geologic history.

**Sun City Rockhound Mineral Museum
Sundial Recreation Center
14801 N. 103rd Ave.
Sun City, AZ 85351**

The museum offers private party tours for schools, clubs and individuals. We'd love to show off our museum to your club or private group. If you are interested, please contact the museum at scrockmuseum@gmail.com.



C. Sandoval photo

**Winter Hours
October - April
10 am to 1 pm
Closed Thurs., & Sunday
Summer Hours
May-September 10am-1pm
Saturdays only**

Please take a minute to check out our new website at scrockmuseum.com.

**Sun City Mineral Museum Community Outreach
By Carol Bankert-George Museum Director**

In December, our club was honored to return to The Gardens assisted living facility in Sun City for an encore presentation. Residents enjoyed learning about Arizona's fascinating rocks, minerals, and rich history of mining in the Copper State. Their enthusiasm and curiosity made the experience truly memorable for our club members.

Our outreach doesn't stop there-we regularly participate in STEAM events along with presentations at senior living communities, sharing the wonders of geology with audiences of all ages.



Carol Bankert-George Museum Director
eft by the TV and Cheryl Alvord to the right
of the TV



Google Maps

Arizona Rock and Gem Shows

53RD ANNUAL FLAGG GEM & MINERAL SHOW

FREE ADMISSION | FREE PARKING | FREE SAMPLES FOR KIDS
JANUARY, 9 to 11 | 2026



QUARTZ ON CHRYSOCOLLA
BAGDAD MINE, YAVAPAI CO., ARIZONA
PAULA & LES PRESMYK COLLECTION
PHOTO BY JEFF SCOVIL



GEM SILICA
LINE OAK PIT, GILA CO., ARIZONA
PAULA & LES PRESMYK COLLECTION
PHOTO BY STAN CELESTIAN



QUARTZ ON CHRYSOCOLLA
OLD DOMINION MINE, GILA CO., ARIZONA
PAULA & LES PRESMYK COLLECTION
PHOTO BY JEFF SCOVIL



GEM SILICA
INSPIRATION MINE, GILA CO., ARIZONA
PAUL HARTER COLLECTION
PHOTO BY STAN CELESTIAN



QUARTZ ON CHRYSOCOLLA
RAY MINE, KEARNY, ARIZONA
SCOTT RUDOLPH COLLECTION
PHOTO BY JEFF SCOVIL



QUARTZ ON CHRYSOCOLLA
RAY MINE, KEARNY, ARIZONA
SCOTT RUDOLPH COLLECTION
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MESA COMMUNITY COLLEGE NE CORNER
OF US 60 AND DOBSON ROAD
FRI-SAT 10AM - 5PM | SUN 10AM - 4PM
www.Flaggshow.info



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WWW.GILAGEM.ORG



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FRI & SAT 9-5, SUN 10-4**

**BEVERLY: 928-402-0559
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Arizona Rock and Gem Clubs



Apache Junction Rock & Gem Club

Meetings are on the 2nd Thursday
Next Meeting: January 8, 2026, 6:30 pm

www.ajrockclub.com

@ Club Lapidary Shop

2151 W. Superstition Blvd., Apache Jct.



Daisy Mountain Rock & Mineral Club

Meetings are on the 1st Tuesday
(unless a Holiday then 2nd Tuesday)

Next Meeting: January 6, 2026, 6:30 p.m.

www.dmrmc.com

@ Anthem Civic Building

3701 W. Anthem Way, Anthem, AZ



Maricopa Lapidary Society, Inc

Meetings are on the 3rd Tuesday

Next Meeting: January 20, 2026, 7:00 pm

www.maricopalapidarysociety.com

@ North Mountain Visitor Center

12950 N. 7th St., Phoenix, AZ



Mineralogical Society of Arizona

Meetings are usually on the 3rd Thursday
(Except June & December)

January 15, 2026, 6:30 pm

@ Franciscan Renewal Center, (Piper Hall),

5802 E. Lincoln Drive, Scottsdale, AZ

www.msaz.org



Pinal Geology & Mineral Society

Meetings are on the 3rd Wednesday
Next Meeting: January 21, 2026, 7:00 pm

www.pinalgeologymuseum.org

351 N. Arizona Blvd., Coolidge



West Valley Rock & Mineral Club

Meetings are on the 2nd Tuesday

Next Meeting: January 13, 2026, 6:30 pm

www.westvalleyrockandmineralclub.com

Buckeye Community Veterans Service Center

402 E. Narramore Avenue, Buckeye, AZ



Gila County Gem & Mineral Society

Meetings are on the 1st Thursday
(unless a Holiday then the next Thursday)

Next Meeting January 8, 2026, 6:30 pm

www.gilagem.org

Club Building

413 Live Oak St, Miami, AZ



Wickenburg Gem & Mineral Society

Meetings are on the 2nd Friday

(February & December on the 1st Friday)

Next Meeting: January 9, 2026, 7:00 pm

www.wickenburggms.org

@ Coffinger Park Banquet Room

175 E. Swilling St., Wickenburg, AZ

ESM’s Meeting Notice

ESM’s next meeting will be at North Mountain Visitor Center, 12950 N. 7th St., Phoenix, on Tuesday, TBA 2026, at 6:30 p.m.

BECOME A MEMBER!
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Membership benefits:

- ◆ Monthly e-newsletter *Earthquake*
- ◆ Official team membership card
- ◆ Knowledge that your contribution is making a difference in earth science education.

MANY THANKS TO OUR MAJOR DONORS!

AZ Leaverite Rock & Gem Society

Flagg Mineral Foundation

www.flaggmineralfoundation.org

Friends of the AZ Mining & Mineral Museum

Maricopa Lapidary Society

<http://maricopalapidarysociety.com/>

Mineralogical Society of AZ

www.msaaaz.org

Payson Rimstones Rock Club

<https://www.rimstonesrockclub.org/>

Sossaman Middle School

White Mountain Gem & Mineral Club

www.whitemountain-azrockclub.org

Sun City Rockhound Club & Mineral Museum

<https://suncityaz.org/recreation/clubs/rockhound-club-mineral-museums/>

Wickenburg Gem & Mineral Society

<http://www.wickenburggms.org>

www.facebook.com/pages/Wickenburg-Gem-and-Mineral-Society/111216602326438

West Valley Rock and Mineral Club

<http://www.westvalleyrockandmineralclub.com/>

Staples Foundation

www.staplesfoundation.org

| | |
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Phone:

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Editor E-Mail:

scote@earthsciencemuseum.org

Mission

Our Mission is to excite and inspire all generations about earth sciences through educational outreach.

Vision

We envision a community where students and the general public have curiosity about, passion for, and understanding of the underlying principles of earth sciences.

For more information about the ESM, how to become a member or how to arrange for a school visit or Community function, go to: www.earthsciencemuseum.org.

We're on the Web!

Visit us at:

www.earthsciencemuseum.org

NOTICE:

ESM's next meeting will be at North Mountain Visitor Center, 12950 N 7th St, Phoenix, on Tuesday, TBA 2026, at 6:30 p.m.

THANK YOU FOR YOUR CONTINUING INTEREST & SUPPORT!!!

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