



The Mineral Newsletter

Meeting: February 28 Time: 7:30 p.m.

The meeting will be online only due to the coronavirus pandemic. Details on page 7.



Linarite

**Blanchard Mine, Socorro County,
New Mexico**

Source: Mindat.

Photo: Norman and Josine Robinson Collection.

Volume 62, No. 2

February 2022

Explore our [website!](#)

February Meeting Program:

Amber

Details on page 7

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Mineral of the Month Linarite

by Sue Marcus

Our February Mineral of the Month is the vividly blue mineral linarite. This mineral was originally described by H.I. Brooke in 1822. The specimens Brooke described came from Wanloch Head (now Wanlockhead) or Lead Hills (now Leadhills), south of Glasgow, Scotland. Oddly, though Brooke described the new mineral relatively well for the times, he gave it no name.

Linarite, though apparently first described by a Scot based on Scottish specimens, was named for Linares, Spain, where it is also found. The name was bestowed in 1839 by E.F. Glocker, who seems to have been an interesting fellow. This German mineralogist, geologist, and paleontologist originally studied theology and philosophy before moving to the hard sciences. He named several minerals, including linarite. Neither the original Scottish locality nor the Spanish one is known for attractive or abundant specimens.

Linarite can be confused with azurite. Linarite, a sulfate, does not effervesce in acid; azurite, a carbonate, does, although most of us would prefer not to damage nice specimens with acid testing. Although they are visually similar—both blue and both monoclinic—azurite is slightly harder at 3.5 to 4 on the Mohs scale versus linarite at 2.5. As a secondary mineral, linarite can form pseudomorphs after other minerals, notably galena. In turn, linarite can be pseudomorphed by malachite.

The American Southwest has been a significant source of linarite specimens from several locations associated with the lead-copper districts there. The Mammoth Mine and the St. Anthony Shaft within it, in the bygone town of [Tiger, AZ](#), were a source of some of the world's best linarite specimens. Mindat shows [a matrix specimen](#) that is 8 centimeters (3.1 in) long, with a vug containing linarite crystals more than 1.5 centimeters (0.6 in) standing out in it. The bright blue linarite is set off by malachite and cerussite. Unlike specimens from most localities, the best from this one feature three-dimensional crystals on their own or popping out from matrix, not flattened (as at many other sites). Colors of the Tiger material can range from electric blue through almost black in undamaged thicker crystals. Micromounters have many op-

Happy Valentine's Day!



Northern Virginia Mineral Club members:

The November club meeting will be another online-only meeting via Zoom on **February 28, 7:30 p.m.**

The program will be on amber. See details starting on page 7.



Linarite from Linares, Andalusia, Spain. Source: Wikimedia; photo: Christian Rewitzer.

portunities to find, or more likely purchase, stellar specimens from this site too.

A rival to the Tiger locality is the former [Grand Reef Mine](#) in the Aravaipa Mining District in Graham County, AZ. Many of the best linarite crystals are in vugs in brecciated host rocks. One Mindat [image of a specimen](#) 8 by 7 centimeters (3.1 by 2.8 in) in size shows gemmy linarite crystals, as fine as the best Tsumeb azurite, in the central part of a zoned vug. In the image, the vug is open vertically, with the central linarite surrounded by druzy quartz, followed in outward succession by an intermittent band of an uniden-

tified black mineral, then another quartz zone, another intermittent band of the black mineral, then the breccia. The zoning and brecciation tell a geologic story about the formation of the specimen that can help geologists and those seeking mineral deposits determine where to seek similar ones.

Images of larger specimens were also posted on Mindat, though none as fine as the one just described. Production began in 1915, with lead and copper being the primary commodities hosted in the Pinal schist. Faulting caused the brecciation, allowing ore-bearing fluids to travel into the cracked pathways, followed by formation of secondary minerals like linarite. The Grand Reef Mine produced intermittently from 1915 (one source says 1907) to 1941.

Ross (1925) noted minor linarite at the nearby Tenstrike claim group but did not mention this mineral at the Grand Reef Mine. He suggested that the Tenstrike group was staked over an extension of the Grand Reef deposit. Mineral collectors have found linarite micros at mines in the [Bisbee, AZ](#), area, though specimens seem small and scarce.

The [Blanchard Mine](#) near Socorro, NM, is famous for its blue fluorite. The deposit was exploited for lead, producing lovely linarite specimens along with the fluorite. The juxtaposition of bright blue, lustrous prisms of linarite crystals contrasting with the quartz or quartzite matrix makes these desirable additions for any collector. The quartz matrix is stained yellow in some specimens, probably due to iron oxides. Linarite crystals range from up to about 1 centimeters (0.4 in) on a small piece of matrix to a specimen, including matrix, that is 61 centimeters (2 ft) in size, with several flat, radiating linarite sprays. That whopper of a specimen belongs to the New Mexico Bureau of Geology and Mineral Resources Mineral Museum. Cerussite, anglesite, and barite are other common associations in Blanchard Mine linarite specimens.

Farther west, in California, the Darwin Mining District produced rare, fine linarite specimens. Mindat shows a specimen, 6.8 centimeters (2.7 in) in its maximum dimension, with translucent, deep blue platy linarite crystals sticking out vertically from a 3-centimeter (1.2-in) vug.

About 30 miles north of Darwin, linarite also occurs in the [Cerro Gordo](#) Mining District. Showy linarite



*Linarite, Mammoth-St. Anthony Mine, Tiger, Pinal County, AZ.
Photo: iRocks.com.*

crystals are rare or absent, though flattened crystals and microcrystals in vugs were recovered by collectors. Galena provided the source of the lead; it was introduced in the last two of three phases of mineralization. The tectonic history of the area is complex, with faulting before and after mineralization and before and after introduction of the igneous plutons in the region. The area is still seismically active. Limestone was cooked by the intrusions, becoming marble. Silicification flooded in weaker areas, bringing in mineralizing fluids.

Southern California's [Blue Bell Mine](#) is fun for several reasons. The linarite from here is mostly of interest to micromounters, although rare macrocrystals have been found too. Matrix specimens with lathes of linarite were collected from the site at least as late as 2019. The property is on public land; therefore, unless covered by mining claims, it could be open to collectors.



Top: Linarite, Darwin, Inyo County, CA.

Right: Linarite with caledonite, Baker, El Dorado County, CA. Source: Wikipedia; photos: Rob Lavinsky.



I like words, and this locality provides fun in that department. The closest “place” is Zzyzx—fun word—about 7.7 miles west of Baker. When Roger and I worked in the California desert and regularly passed through Baker, we’d stop at one of the Baker Bun Boys for a burger.

[Caldbeck Fells](#), in northwest England, offered specimens for macro- and microcollectors. Many of these are matrix specimens; rare specimens have lovely, translucent, gemmy linarite crystals. One specimen shown on Mindat displays a 1.5-centimeter (0.6-in) crystal. Some of the specimens from this area occur in breccia matrix; others are in apparently leached matrix, as I interpret the Mindat photos. Self-collecting was occurring at least through 2008.

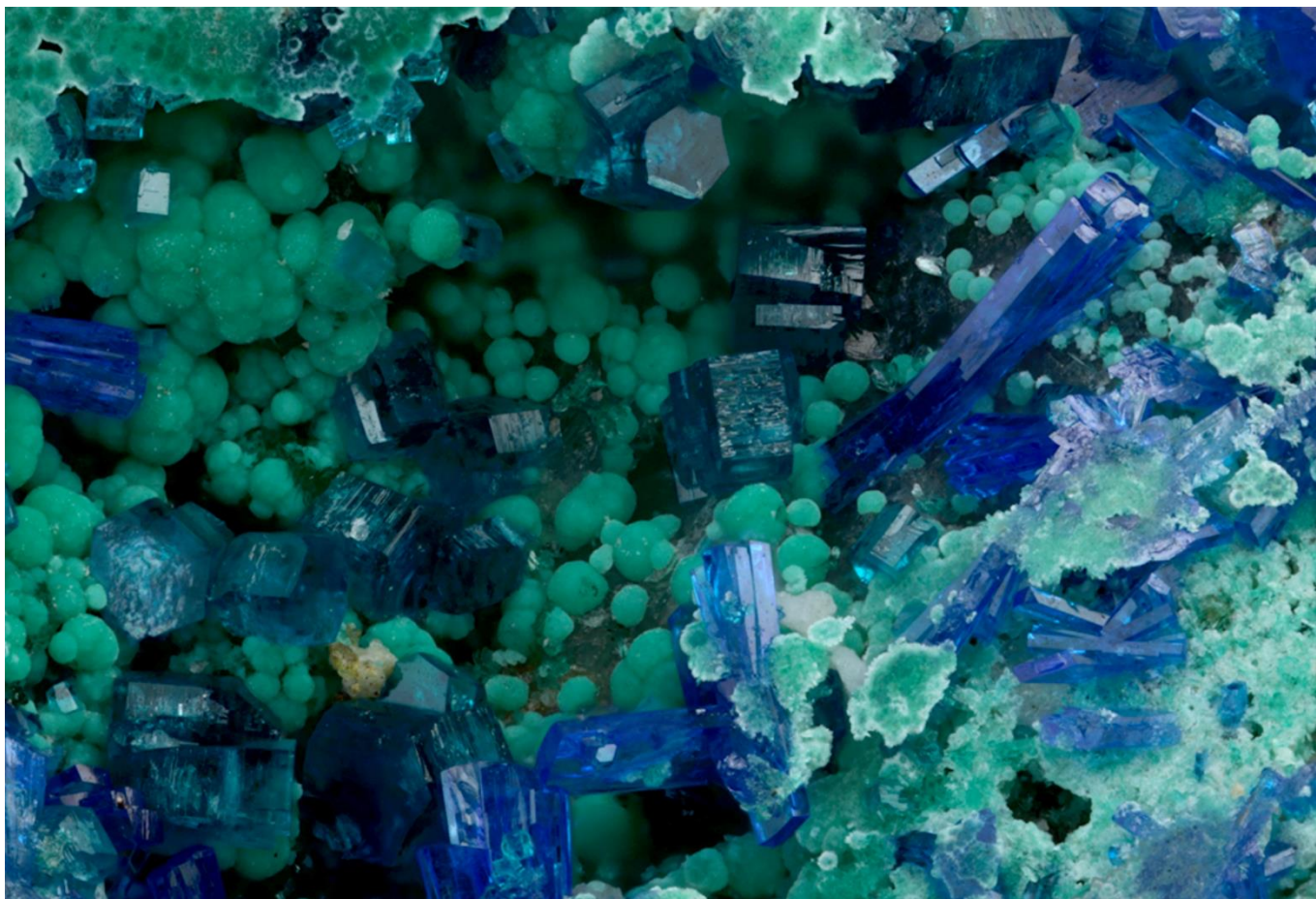
Micromounters alert! Fellow collectors found gorgeous translucent tufts of tiny linarite crystals at the [Eaglebrook Mine](#), near Tal-y-bont, Wales. The photos on the Mindat site for this mine are my ideal of a micro for this species. The area is now closed to collecting despite amateurs being the ones who initially identified the long-closed site’s interesting mineralogy.

A lead–silver deposit was mined in the 16th century and possibly as early as the 14th century in Kletné, near Suchdol nad Odrou, in what is now the Czech Republic. Linarite was identified in samples from the dumps in 2016. Specimens consist of microcrystals or coatings.

Many beautiful minerals for micromounters have been found in Sardinia, Italy, as some mineral club members may recall from the well-illustrated presentation by Beth Heesacker. The linarite from Sardinia is for these collectors. Though visible in hand samples, the crystals show best as micros. Linarite micros from the Baccu Locci Mine can be transparent in various shades of blue. Terminated crystals, tufts, and sprays all make for pretty eye candy. Linarite from the [Montevecchio Mines](#) is similar to that found at Baccu Locci, but because the former is now part of a UNESCO Geopark, specimen collecting is probably not allowed. Mining commenced at Montevecchio by ancient Roman times and possibly earlier.



*Linarite, Eaglebrook Mine, Ceredigion, Wales.
Source: Mindat; photo: Frédéric Hède.*



*Linarite with langorite and malachite, Bergmannstrost Mine, Rheinland-Pfalz, Germany.
Source: Mindat; photo: Y. Vessely.*

In 2012 and 2013, [Anastasios Tsinnidis](#) opened a vein at the [King Arthur Mine](#) near Kirki, Greece, and extracted more than 500 specimens. His discovery included linarite crystals up to 1 centimeter (0.4 in) long, some with brochantite, cerussite, or coatings of cerussite. Specimens reach at least 7 centimeters (2.8 in) long; one specimen is a crystal-lined vug 3 centimeters (1.2 in) long.

That zone was mined out. Might there be others?

Farther south, linarite from the [Megala Perfka Mine no. 28](#) in Laurium, Greece, forms tiny deep blue sprays suitable for micromounts. They are pretty, though not in the same class as the King Arthur Mine material.

Morocco is an active producer of many beautiful minerals, and linarite is one of them. Attractive linarite specimens are coming from [Goulmima](#) near Errachidia. Micromount collectors might enjoy the

contrasting colors and textures of bright blue linarite set off by bright green brochantite. The colors and textures of the minerals contrast nicely, although individual linarite crystals are seldom large enough to excite macrocollectors. There are always exceptions; Mindat offers a photo of one specimen that is 12.8 centimeters (5 in) long, with the largest crystal 0.8 centimeters (0.3 in) in its largest dimension.

Linarite is found in other places in association with lead or copper deposits, such as in dumps or in slightly mineralized zones that catch the eyes of field collectors. Some sources have reported it from the famous [Tsumeb Mine](#) in Namibia, from Chile and Argentina, and from where it was first described in Scotland and Linares, Spain. None of these localities have produced attractive specimens; and, for most places, I could not find any mention of linarite among the minerals reported there.

The relative softness of linarite makes it a poor choice as a gemstone. It has good cleavage in two directions, which also complicates any lapidary uses. Cutting-size pieces are rare. Not stopped by these challenges, faceters have cut stones of up to about 2 carats from Grand Reef, AZ, material. Maybe this is a mineral that should be left to those of us who enjoy it in its natural state.

Linarite is uncommon, and some authors call it rare. I respectfully disagree. Well-terminated crystals that are complete are rare, but specimens with masses of partial crystals or sprays showing some crystal faces, well-embedded in matrix, are available [starting at around \\$40](#). At the other end of the collecting market, there was a [lustrous, partly gemmy thumbnail](#) (with a maximum dimension of 2.6 centimeters (1 in)) listed for \$2,400 when I checked on January 18, 2022.

Technical Details

Chemical formula $\text{PbCu}(\text{SO}_4)(\text{OH})_2$
Crystal form.....Monoclinic
Hardness2.5
Specific gravity.....5.3–5.5
ColorBlue
Streak.....Light blue
Cleavage1 perfect, 1 imperfect
Fracture.....Conchoidal
Luster.....Vitreous, adamantine

Sources

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Meeting Minutes January 24, 2022

by David MacLean, Secretary

President Tom Kim called the Zoom meeting to order at 7:30 p.m. No minutes were posted in the newsletter from previous club meetings in 2021. Past President Sue Marcus attended the meeting. A guest introduced himself.

Officer and Committee Reports

The president noted that club officers for 2022 still need to be elected. Though serving as interim vice president, Sue Marcus will not continue as vice president in 2022. Tom Kim offered to continue serving as president in 2022 or to serve as vice president if another club member serves in either position. Other interim officers for 2022 include Roger Haskins, Treasurer, and David MacLean, Secretary.

New Business

The treasurer sent a draft NVMC 2022 budget to elected club officers. It was not discussed. Jason Zeibel asked for advice on the Tucson Show, which he and his family were planning on attending for the first time.

Club members discussed opportunities for club activities in 2022, including at meetings. Field trip possibilities include:

- Fairy Stone State Park near Martinsville, VA, for staurolites. It's a 6-hour drive from northern Virginia so it would be an overnight trip. Roger Haskins volunteered to initiate planning.
- The Edison site, Sterling Hill, near Franklin, NJ, for fluorescent minerals. The annual SuperDiggg is a possibility.



- The Scufflin Acres Farm in Virginia for quartz.
- Places in Delaware, such as for fossils in the dredgings from the Delaware-Chesapeake Bay canal.
- The Stuart Perry Quarry off Route 50 west of Winchester, VA.
- A quarry in Gettysburg, PA, for minerals in Jurassic diabase.
- Marble quarries in Pennsylvania north of Baltimore, a 3.5-hour drive.
- A limestone quarry near Flintstone, MD, for calcite, strontianite, and sulfur.
- The Penn-Maryland Quarry northeast of Baltimore, a 2.5-hour drive, for diabase minerals.
- The Manassas Quarry in Manassas VA, for diabase minerals. Unless the quarry is blasting near the edges of the quarry, the findings will be poor. Sue Marcus has contact information. Past trips were made together with other local clubs.
- The Chambersburg, PA, and Harrisonburg, VA, clubs seem to have lots of field trips. Reach out to coordinate something?

Other ideas for activities include:

- An outdoor swap and tailgate event at a park or private home. Jason Zeibel offered his family's 5-acre property; before COVID, they were considering offering it for a summer picnic.
- An outdoor or indoor auction.
- An educational outreach equivalent to what was done at club shows until 2019.
- Scout mineral badge classes; instructors would be needed. Kathy Hrechka has ample experience.
- Displays or presentations at schools and public libraries. However, schools are in disarray due to COVID, so it might be best to contact them later. A Zoom presentation that schools can use might be an option, such as a scavenger hunt for common household items with minerals in them.
- Presentations by members at club meetings, focusing on matters of local interest. Jason Zeibel could do a presentation on his planned trip to the Tucson Show or his interest in radioactive minerals.

Announcements

The Gem Lapidary and Mineral Society of Montgomery County is planning a show for 2022 on Saturday and Sunday, March 20-21, at the Montgomery County Fairgrounds, Gaithersburg, MD. Germaine Bouchard is the GLMSMC coordinator.

The Micromineralogists of the National Capitol Area will hold a conference by Zoom on Saturday, April 2.

Show and Tell

Several club members showed specimens of minerals featured as Mineral of the Month in our club newsletter in 2021 and January 2022. ↗

February 28 Club Meeting

Program: Amber

Jorge Santiago-Blay

by Tom Kim, President

For our second meeting in 2022, we're going to hold another online-only club meeting on **February 28 at 7:30 p.m.** Please join us by Zoom at:

<https://us06web.zoom.us/j/89529376777?pwd=QUkvT3lJVVB5djhTcGxtVWpoSnISQT09>

Meeting ID: 895 2937 6777

Passcode: 924880

Our program will be by Dr. Jorge A. Santiago-Blay, a research associate in the Department of Paleobiology, Smithsonian National Museum of Natural History, Washington, DC. Dr. Santiago-Blay will discuss amber. His research seeks to provide answers to this question: What processes cause and what patterns correlate with speciation and biodiversity? Because his training, experience, and interests are multidisciplinary, he seeks answers in numerous areas of biology, including paleobiology, ecology, behavior, development, genetics, molecular biology, biochemistry, and others using different biological systems. Also, he researches a variety of aspects of the history of science, including biology, chemistry, physics, and so on. ↗





President's Collected Thoughts

by Tom Kim

One of the club meetings I distinctly remember from a few years back included a brainstorming session about possible field trips and collecting sites. "I'd love to go on one of those trips," I told myself, "some day."

Well, ever since the pandemic, the appeal of getting out and taking a trip with fellow club members has only grown. And our last club meeting featured another brainstorming session about possible such trips to take.

Four possibilities strike me as good short-term prospects that we could prepare for immediately:

- A trip to Fairy Stone State Park near Martinsville, VA, a good prospect for staurolite crystals.
- A carpool to or meetup at the upcoming GLMSMC show in Montgomery County, to be held on March 19-20.
- A group tour of the new JMU Mineral Museum.
- A trip to the Sterling Hill Edison site near Franklin, NJ, perhaps to the annual SuperDiggg event for fluorescent minerals on April 23.

If any of those trips interest you, please email me at president@novamineral.club. When we have enough commitment to take one or more of these trips, we'll get the ball rolling on them.

In the meantime, we'll reach out to other clubs, like MNCA, GLMSMC, and MSDC, to see whether they are interested in partnering for field trips. We'll even go farther afield and reach out to the Shenandoah Valley club and the Franklin County club, who seem to go on collecting trips with some frequency. And we'll inquire with the Vulcan Materials Company to see if their current activity makes the Manassas Quarry an attractive site for collecting.

We can also do legwork on a number of other prospects and trips, but we'll need some help. If you're interested in helping to prepare or organize a club trip, please email me at president@novamineral.club.

Tom

New Mineral Hitched a Ride to the Surface in a Diamond

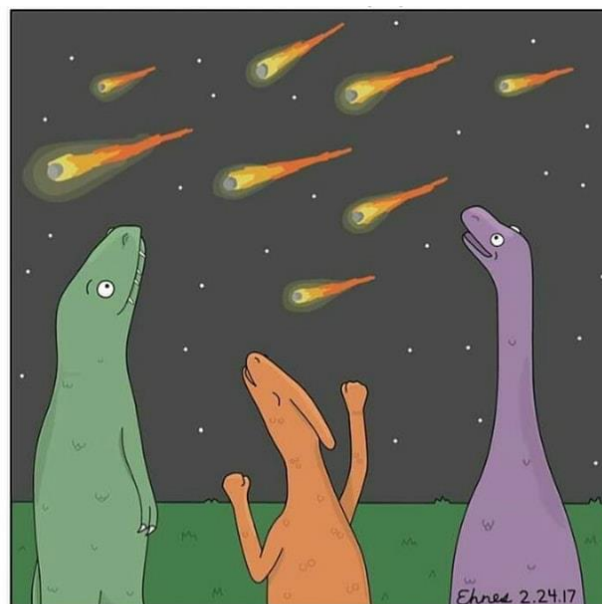
By Rasha Aridi

Editor's note: The article is in Smithsonian Magazine (November 16, 2021). Thanks to Sue Marcus for the reference!



A team of scientists has discovered a new mineral trapped within a diamond, according to a new study in the journal [Science](#). The Earth's mantle, a thick layer of mostly viscous rock, is characterized by intense heat and crushing pressure, which makes it difficult for geologists to study. Instead, they study the minerals and rocks that come to the surface, typically in volcanic eruptions—so this was a rare find.

The researchers named the mineral *davemaoite*, after the well-known geophysicist Ho-kwang (Dave) Mao. The mineral—calcium silicate perovskite—originated more than 400 miles underground and provides geologists with a glimpse of the chemical makeup of the lower mantle. ... [Read more](#).



Sadly, the enthusiasm of the Dinosaur Astronomy Club was short lived.



Wildacres in Spring

Wildacres is a fantastic retreat located on Pompeys Knob just off the Blue Ridge Parkway about an hour north of Asheville, NC. Signing up for the May 16–22 session will give you the opportunity to take one or two classes; hear excellent talks from the guest

speaker, Dr. Nathalie Brandes; and participate in a variety of other activities.

You can register on the [EFMLS Wildacres website](#). The guest speaker and the courses listed below are firmly lined up for May. ➤

Coming to Wildacres in May 2022 ...

Cabochons—Basic (*Bernie Emery*): Transform rock into a cabochon. Learn trim saw, grinding, sanding, and polishing. Slabs provided or use your own. Bring apron, safety glasses. No experience needed. 2-day class, semester 1.

Cabochons—Intermediate (*Bernie Emery*): Learn techniques for cutting different shapes. Slabs provided or use your own. Bring apron, safety glasses. Prior experience with cabbing and trim saw. 2-day class, semester 2.

Faceting (*Reivan Zeleznik*): Learn to cut/polish a 57-facet round brilliant gemstone, identify well-cut stones, and select rough material. Bring optivisor; jeweler's loupe needed, can be purchased. No experience needed. 4-day class.

Fold forming/cold connections I (*Micah Kirby*): Intro to fold forming & connecting base metals w/o heat. Use forming tools & hammers, wire, tubing, & rivets as fasteners. Explore design concepts w/texturing, using stamps, hammers, & rolling mill, plus forming & tab setting techniques. Design an air chased cuff from copper tubing & a pair of matching earrings. Gain knowledge of texturing & forming the cuff. 2-day class, semester 1.

Fold forming/cold connections II (*Micah Kirby*): Design/fabricate a pair of earrings & pendant, combining multiple pieces & connecting with wire, tube, or rivet. Use stamps, hammer, or rolling mill to texture. The pendant will involve a tab set stone/found object & finish w/tumbling. 2-day class, semester 2.

Geology I (*Rob Robinson*): Learn to interpret rocks to tell geologic history. A field trip to local rock exposures will illustrate local rock types, deformation types, and how to map/interpret structures (limited walking required). Bring loupe, sturdy shoes, outdoor clothes, geologic hammer, safety glasses. No experience needed. 2-day class, smstr 1.

Geology II (*Rob Robinson*): Learn plate tectonics & geologic history of Blue Ridge region/minerals. Discover geologic environments of mineral/gem collecting sites; identify your own collecting localities. Field trip with 1-mile walk over gentle trails. Same clothing/gear as Geology I. Basic knowledge preferred. 2-day class, semester 2.

Intro to inlay I (*Chuck Bruce*): Construct inlay box pendant; your choice thereafter. Bring basic silver tools, pocketknife or scribe. Bring/purchase 2-3 slabs of rock of similar hardness, wood, fossil ivory, which can be combined for inlay. Pattern stones do well w/plain colored stone. Expect waste rock. 2-day class, semester 1.

Intro to inlay II (*Chuck Bruce*): Finish fabrication of small trapper folding knife. Bring basic silver tools, pocketknife or scribe. Bring/purchase 2-3 slabs of rock of similar hardness, wood, fossil ivory, which can be combined for inlay. Pattern stones do well w/plain colored stone. Expect waste rock. 2-day class, semester 2.

Silversmithing I (*Richard Meszler*): Learn to work silver sheet & wire to fabricate jewelry. You get a kit with metals/supplies & a step-by-step description of each project. No experience needed. 2-day class, semester 1.

Silversmithing II (*Richard Meszler*): Learn to make a bezel setting & bail for setting a cabochon to make a pendant. You get a kit with all you need. Basic silversmithing experience, including soldering. 2-day class, semester 2.

Soapstone Carving (*Sandy Cline*): Learn the material/tools/methods used to complete a carving. Produce a simple piece; progress toward a more advanced sculpture. No experience needed. 2-day class, both semesters.

Wirewrapping (*Jacelyn Campbell*): Use pliers/gold-filled or sterling silver wire/assorted beads or gemstones/ basic wirecraft techniques to create rings, bracelets, pendants, and earrings. All tools/materials provided.

Session I (beginner): Make an adjustable ring, 2 bracelets, a pendant, & 2 pairs of earrings. 2-day class, semester 1.

Session II (interm): Make a fitted ring, 2 pairs of earrings, a cabochon pendant, & a bracelet. 2-day class, smstr 2.



Physical Properties of Gems and Minerals Durability

by Barbara Smigel

Editor's note: Ever wonder that the “technical details” for a mineral mean? As part of her [online course on gemology](#), the author describes some. This article, adapted from the original, examines hardness (as part of durability).

The durability of a gem or mineral depends on three factors: hardness, toughness, and stability.

Hardness

The tendency to resist scratching in a gem or mineral is known as its hardness. Even folks with just a passing interest in minerals know that they can be ranked on a scale of hardness. Hardness is primarily the result of the strength of the chemical bonds between the mineral's constituent atoms (how tightly they are bound to one another).

The hardness of a gem affects its wearability, luster, and resistance to cutting and polishing. All other factors being equal, harder gems are more usable in jewelry, develop a brighter surface luster, and take more time and effort to cut and polish. They will retain their polish longer than softer gems, given equal wear and tear.

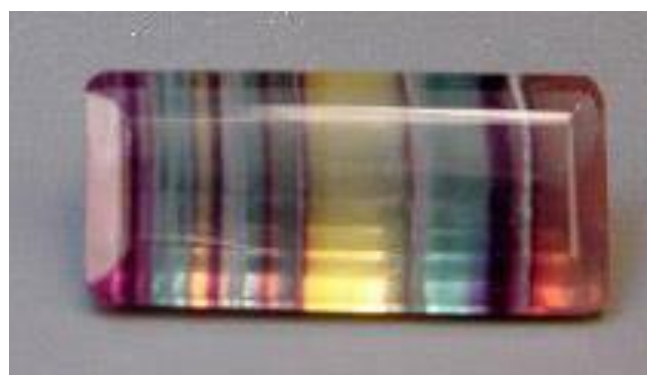
The familiar Mohs Scale for hardness is a kind of “pecking order:” gems ranked at a higher number on the scale can scratch those ranked lower. Friedrich Mohs, a 19th-century German mineralogist, was the originator, and we still use his scale. For example, talc = 1; quartz = 7; and diamond = 10.

But don't be fooled: the Mohs Scale is not linear. A mineral with a reading of 5 is not penetrated by half the force needed for a material ranked at 10. Corundum, ranked 9 on the Mohs Scale, is not “almost” as hard as diamond; it takes many times more force to penetrate a diamond surface than a corundum one!

In mineralogy, one of the key tests commonly used for purposes of identification is a “scratch” test, done with a set of implements known as hardness points. These “pencils” are tipped with various minerals (or metals) of known hardness. By drawing them in sequence across the surface of an unknown mineral, the tester can determine the sample's approximate hardness.



The Mohs Scale for hardness ranges from 1 for talc (left, the softest material) to 10 for diamond (right, the hardest).



Gems with Mohs hardness levels ranging from soft (top—fluorite, 4); to intermediate (above left—tanzanite, 6.5); to hard (above right, ruby, 9).

In gemology, such tests are rarely done because they are destructive. Exceptions might be testing the bottom of a carving, a piece of gem rough, or a bit of material that has broken off. Another drawback of the standard hardness points is that they are not precise, giving only a “ballpark” estimate.

In a laboratory setting, exquisitely precise measurements can be made with sclerometers. These devices use diamond-tipped, hydraulically operated probes to give an absolute reading on the force necessary to penetrate the surface of a material.

Not many rockhounds carry hardness points around with them on their treks, but just a few ordinary materials let you do pretty good hardness tests in the field:

- 1-2: easily scratched by fingernail;
- 3-4: scratched by copper coin;
- 5-6: easily (or not so easily) scratched with pocketknife;
- 7: scratches window glass/scratched by steel file;
- 8-10: scratches window glass but not scratched by steel file.

Toughness

The tendency to resist breaking and chipping is known as a gem's toughness. This property is controlled primarily by two factors: the readiness of a material to cleave in single crystal gems; and the presence or absence of certain structural characteristics that promote strength and cohesion. Toughness isn't measured on a numeric scale but rather in relative terms such as exceptional, excellent, good, fair, and poor.

All other factors being equal, the harder the gem, the tougher it will be, but all other factors are not always equal. Take topaz, for example. At hardness 8, it seems to be a pretty rugged gem, but with its strong tendency to cleave in one direction, it is actually rather fragile. Similarly, diamond is ranked as no better than good in toughness because of its cleavage and fracture potential.

Nephrite jade, with a hardness of 6.5, might seem to be comparatively delicate. However, due to the felted, fibrous nature of its aggregate crystals, it is literally the toughest lapidary material on Earth! Pearls, with their softness, would hardly be wearable except for their moderately good toughness due to their layered, overlapping aragonite plates and the proteinaceous "mortar" that holds these bricklike layers together.

Toughness affects both wearability and resistance to polishing. Jade gems thousands of years old are as beautiful today as when they were first made.

Stability

Stability in a gem is a measure of its ability to resist changes due to exposure to light, heat, and chemicals. Stability not only affects wearability but also dictates appropriate ways of fashioning, cleaning, and storing gems. Most gems are stable, but a few (even some



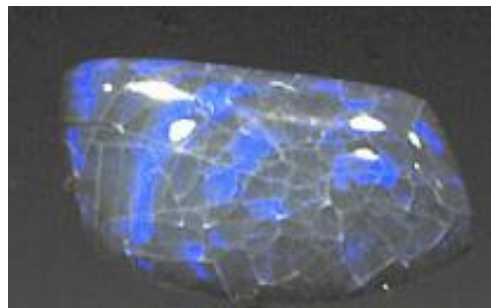
Gems with toughness levels ranging from poor (top left, topaz); to fair (top right, tourmaline); to good (bottom left, chrysoprase (quartz); to excellent (bottom middle, hematite); to exceptional (bottom right, jade).

quite popular ones) are unstable, and must be handled accordingly.

Heat can create problems with certain gems and minerals. In some cases, the mineral is "hydrated" (contains water molecules that adhere chemically with varying degrees of tenacity). When the water is loosely attached, hot dry air can evaporate it, changing the color or transparency of the mineral. Even more seriously, water loss can cause a network of cracks to form in a process called "crazing."

Opal is known for this issue. Reputable opal dealers "proof" their material by subjecting it to hot dry conditions for months before selling it. The pieces that survive such treatment will generally be stable under normal wearing conditions.

Another problem that heat can create for some gems and minerals is "thermal expansion." Diamonds are resistant to temperature changes, but gems such as



A badly crazed opal.



“Sun spangles”—stress fractures in heated amber.

apatite expand so rapidly with sharp rises in temperature that their crystal structure is damaged; they can crack and even shatter. Heat

sensitivity means that lapidaries need to keep the gem or mineral cool during cutting or mounting.

A gem or mineral might be quite stable but not the inclusions within it. During heat treatments to enhance gems, inclusions can expand enough to create “stress cracks.” In some cases, the cracks might be deliberately induced: amber, heated and then quickly cooled, can develop disklike stress fractures called “sun spangles” that some consider attractive.

Some gems and minerals can fade or change color when exposed to light. An extreme example is the rare mineral pyrargyrite; unless kept under opaque covers, light exposure quickly renders its originally red color completely black. Kunzite (pink spodumene) can lighten in color with long-term exposure to bright light; it is sometimes suggested as an “evening-only” gem. Certain brown topazes, notably those from Mexico, can lighten dramatically with continuous light exposure, even becoming colorless.

Exposure to various chemicals can discolor certain lapidary materials or ruin their polish. Carbonate gems like rhodochrosite degrade when exposed to acids, and acetone can dissolve amber. Acid vapors in urban air pollution can take their toll over time. ↗



Unstable gems. Apatite and opal (top) are heat sensitive; Mexican brown topaz (bottom left) fades in light; turquoise (bottom right) is porous and will discolor when exposed to various substances.

Most unstable gems are sensitive due to their porosity rather than their chemical makeup. Pearls and turquoise are known for their propensity to absorb cosmetics, perfumes, body oils, and so on, discoloring as a result. Fine turquoise gems are often given a final polish with a layer of colorless paraffin wax to help seal and protect them from degradation. Lightly wiping chemically sensitive gems with a damp cloth after each wearing will help to keep them in good shape. ↗

Bench Tip Magnetic Tool Bar

Brad Smith

An easy way to keep all your files organized at the bench is to use a magnetic tool strip. They're not expensive and help keep a lot of small tools from cluttering the benchtop. I got a couple of them from Harbor Freight for about \$5 each. Search “magnetic holder” at <http://www.harborfreight.com>.

My only regret was putting some of my small drills on the magnets. The drills got a little magnetized and now stick together when I carry them in a bottle in my toolbox.

Smart Solutions for Your Jewelry Making Problems
[amazon.com/author/bradfordsmith](https://www.amazon.com/author/bradfordsmith)



2022 Is Setting Up To Be the Year of the Fluorescents!

by Philip S. Neuhoff, Ph.D.

Editor's note: The article is adapted from Grindings (newsletter of the Idaho Gem Club, Boise, ID), January 2022, p. 6.

It has never been a better time to be interested in fluorescent minerals!

The Show That Glows

The year 2021 marked the 50th anniversary of the founding of the Fluorescent Mineral Society. As part of the celebration, the Tucson Gem and Mineral Show (TGMS) had planned on having fluorescent minerals as its theme (“The Show that Glows”). Unfortunately, TGMS was cancelled due to the COVID-19 pandemic, and the celebration got pushed to 2022.

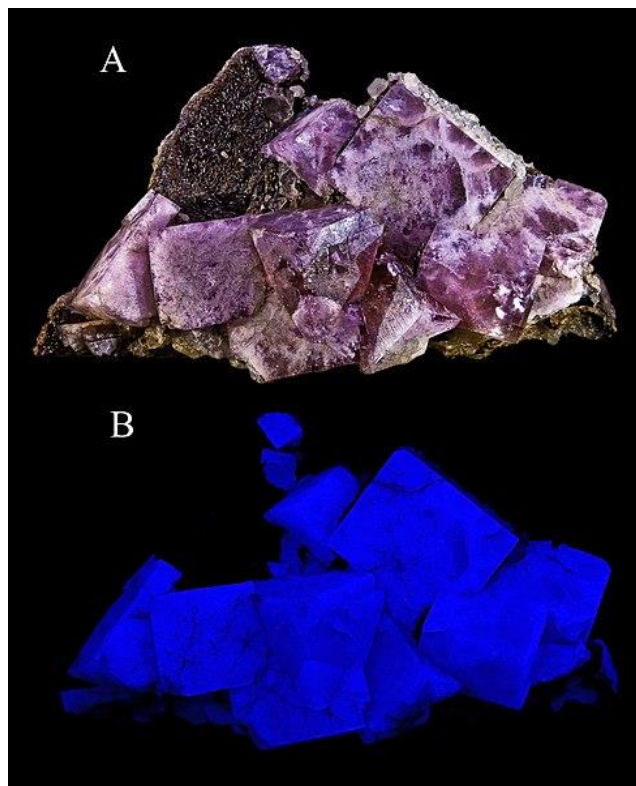
As I write this, I and many others are preparing exhibits for what promises to be the greatest exhibition of fluorescent minerals ever assembled, to be shown in a special space at TGMS in February. In some ways, the delay of this exhibition to 2022 is somewhat fortuitous, because the world of fluorescent mineral collecting is on the cusp of being forever transformed.

Ultraviolet Flashlights

Many readers are probably familiar with the relatively new longwave (LW, 365 nm) LED flashlights that have made fluorescent mineral collecting far more affordable and exciting than in the past. The concentrated beams generated by these flashlights, along with their small size, make it possible to see fluorescent responses even in well-lit rooms (like at gem shows) and are far easier to use and more effective in the field. This has been a great boon to the hobby.

Most fluorescent minerals, however, are not responsive to LW ultraviolet (UV) light and require shorter wavelengths to generate a fluorescent response. A revolution is afoot to make collecting and enjoying all fluorescent minerals as enjoyable as those that respond to LW flashlights.

Up until now, the only way to enjoy the beauty of minerals that respond to shorter wavelengths was to use fluorescent tube lamps that generate shortwave (SW, 254 nm) or midwave (MW, 312 nm) UV light. Lamps of this style with enough power to sensibly



*Fluorescing fluorite from the Boltsburn Mine, Durham, England.
Source: Wikipedia; photo: Didier Descouens.*

use in the field (or illuminate a display case in the blacklight tent at a mineral show) are expensive; they start at \$500 or so, and cheaper lights do not have the power or the lifespan to be really useful. Part of the problem with SW and MW lamps is that they require filters that are transparent to UV but block most of the visible light so that the fluorescent response is not drowned out. Longwave lights also need a filter, but the filters are relatively inexpensive. Filters that transmit SW and MW UV are very expensive, and the large areas of filter needed to transmit the radiation produced by SW and MW tubes leads to higher costs for these lights.

In addition, SW UV light actually degrades the filter through a process called solarization, so the amount of UV light transmitted through the filter decreases over time. Moreover, SW and MW tubes are relatively large—far larger than the flashlights that now house LW LEDs.

Advances in SW Affordability

Just within the last year, SW and MW LEDs have been brought to market that are powerful enough and more or less cost-effective enough to use for collect-

ing fluorescent minerals. The technology behind these LEDs evolves daily, with increases in power and decreases in cost the main consequences. The SW and MW LEDs remain more expensive than the LW LED flashlights that can now be purchased for only about \$20, but there are commercially available flashlights generating SW and MW UV available for less than \$200. Power and cost will certainly go down as this sector of the LED market grows, partially in response to disinfection applications.

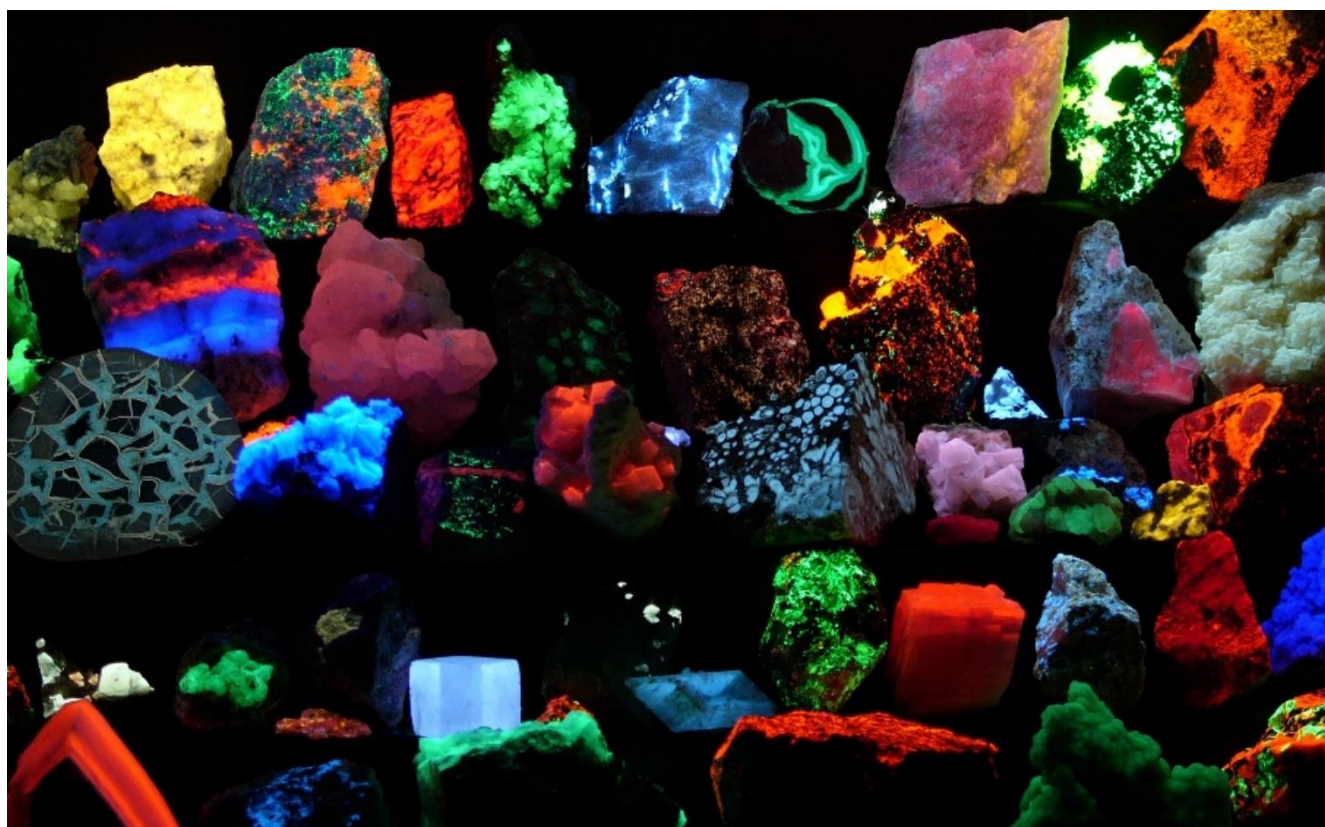
Other exciting innovations are happening as well. Many UV lights use what are called bandpass filters, essentially colored glass filters that are relatively transparent to UV but block most visible light. These filters are subject to solarization.

Another type of filter, called a dichroic filter, can also transmit UV but block visible light. These filters have some special requirements that are beyond the scope of this article and are also very expensive. Significant progress has been made with this type of filter, and its use with UV LEDs promises to further revolutionize lighting solutions for collecting and displaying fluorescent minerals.

The upshot is that this will (1) improve the performance of UV lights; (2) ultimately decrease their cost; and (3) make it possible to have small form factor lights like flashlights that can generate multiple types of UV light, either one at a time or multiple wavelengths together. Within a year, you might be able to purchase a flashlight (or a small handheld light) that can be switched between LW, MW, and SW UV or have all of them searching for treasures at the same time.

Fluorescent Mineral Society

Interested in all of this? I strongly encourage you to check out the Fluorescent Mineral Society (FMS) at www.uvminerals.org. Its members have spearheaded the applications of LED technology to fluorescent mineral collecting, and you can get sneak peeks at the advances on the FMS Facebook page “Fluorescent Minerals.” Joining the society gives you access to the great publications it generates and other opportunities to meet and learn from dedicated collectors in this part of our hobby. ↗



Various fluorescent minerals under ultraviolet light. Chemicals in the rocks absorb the ultraviolet light and emit visible light of various colors. Source: Wikipedia; photo: Hannes Grube.



The Rocks Beneath Our Feet **Great Falls: How Did It Get There?** **Part 2—The River**

by Hutch Brown

Great Falls on the Potomac River is a spectacular example of the downcutting power of water on rock. The relatively tough metamorphic bedrock in our area resulted from hundreds of millions of years of sediment deposition and consolidation under the tremendous heat and pressure of multiple mountain-building events. By contrast, the Potomac River took less than 2 to 3 million years to carve the entire 14-mile Potomac Gorge, from Great Falls to Key Bridge.

Geologic Setting

About 300 million years ago, our area was in the middle of a supercontinent and covered by a mountain range the size of the Himalayas today. By about 230 million years ago, the mountains were gone and the supercontinent was starting to break up. As proto-Africa pulled apart from proto-North America, magma rose in great rifts along reactivated faultlines between the continental plates.

Rifting ended by about 180 million years ago. As the continents drifted apart and the Atlantic Ocean widened, a period of tectonic calm followed along the flat Atlantic seaboard (fig. 1, circled). From about 140 million to 100 million years ago, rivers deposited sediments where they slowed at the tidewater, burying the Coastal Plain bedrock under a thickening wedge of sand, silt, and cobble known as the Potomac Formation.

Beginning about 100 million years ago, higher ocean levels covered much of our area for millions of years at a time. The advancing seas left marine deposits, though none remain in our immediate area today. The terraces where people have built homes are made up of riverine deposits laid down from about 10 million to 5 million years ago. The combined sediments on the Coastal Plain, both terrestrial and marine, are up to a mile thick at their outer edge.

Then everything changed. The marine transgressions ended; and the rivers, instead of simply thickening the wedge of sediments on the Coastal Plain, quickened their pace and started cutting down through the bedrock in the Piedmont and points west.

How and why did it happen?



Great Falls on the Potomac River.
Source: Wikipedia.



Figure 1—North America about 105 million years ago (our area circled). *Source: Blakey (n.d.).*

Isostatic Rebound

About 5 million years ago, uplift began again in our area due to isostatic adjustments. Reaching from the Piedmont to the Allegheny Plateau, the uplift is due to the aftereffects of the great mountain range that covered our area 300 million years ago.

During mountain building, brittle crustal rock built up on the viscous magma in the Earth's mantle (fig. 2). As the crustal materials piled up to form mountains tens of thousands of feet high, the overlying weight

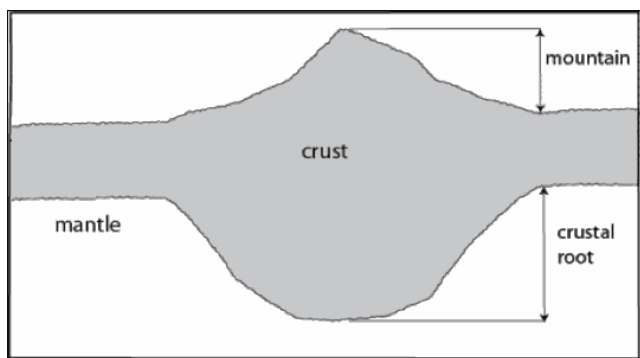


Figure 2—Mountain building associated with accumulations of crustal materials over the viscous mantle rock. As the overlying mountains erode, the mantle rebounds, leading to the isostatic uplift we see in our area today. Source: Marx (2019).

displaced mantle materials underneath. Like an iceberg floating in the sea, the mountain masses exposed only a small part of their enormous bulk: 90 percent of the material remained hidden underground.

As the mountain range eroded away, its weight decreased and the underlying mantle materials rebounded, a process called isostasy. Whereas erosion is relatively rapid and continuous over geologic time, isostatic rebound is slow and episodic. It affects our area today, even after hundreds of millions of years. For about 5 million years, gentle uplift has been raising the Blue Ridge Mountains and uptilting what was once a flat Piedmont plateau.

Riverine Downcutting

As the grade steepened, rivers and streams became faster, cutting down to the bedrock and shaping valleys and ridges across much of our area. Streams arising on the western plateaus found weaknesses in the rock, carving valleys in easily erodible bedrock such as limestone and leaving ridges of harder rock such as shales capped by sandstone.

The valleys and ridges ranged from southwest to northeast, following bedrock patterns left by mountain building 320 million years ago (fig. 3, top). Obstructed by the rising parallel ridges, only the largest rivers retained enough downcutting power to keep pace with the uplift. The Potomac River formed about 3.5 million years ago from tributaries in our area's western valleys. Faults, fractures, and other weaknesses in the rock allowed the river, with its downcutting power amplified by tributaries, to wear away even the hardest bedrock, leaving "water gaps" such

as Harpers Ferry (in Weverton quartzite) and Point of Rocks (in Catoctin greenstone) (fig. 3, bottom).

In the Piedmont, tributaries of the Potomac began carving valleys into the metamorphic bedrock, giving the area its hilly appearance today. The Potomac gradually deepened its own Piedmont valley, leaving remnants of its former floodplains as gravel-covered terraces. By about 2 million years ago, the river had shaped a broad valley in about its present location.

Pleistocene Impacts

Continental glaciation began during the Pleistocene Epoch about 2.6 million years ago, lowering ocean levels worldwide by up to 500 feet. The glaciers

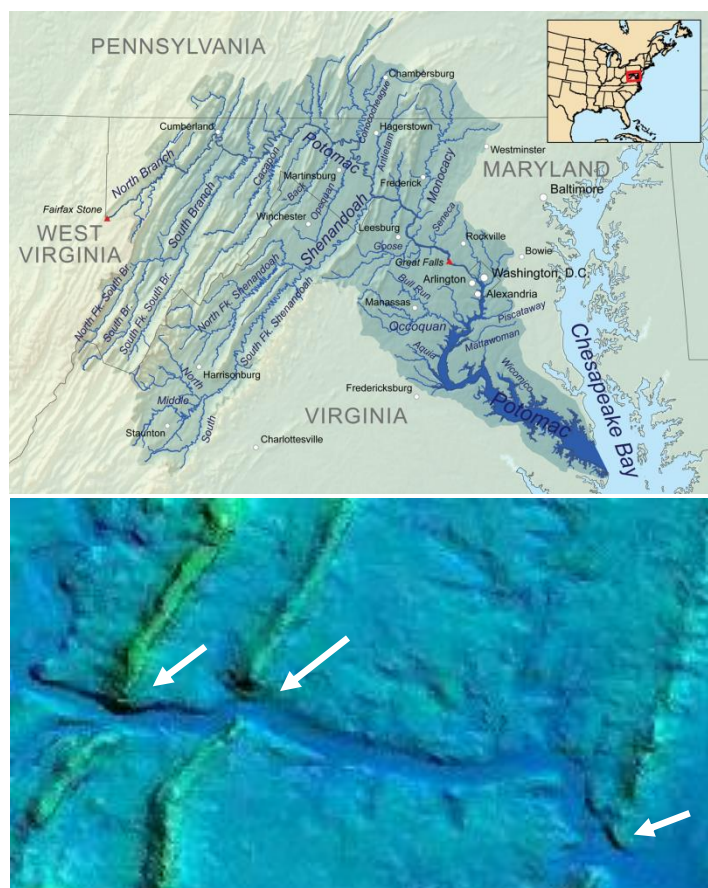


Figure 3—Potomac River basin (top). Like other rivers feeding Chesapeake Bay, the Potomac generally flows from northwest to southeast, but its headwaters flow parallel to the orientation of the region's valleys and ridges from southwest to northeast. After gathering its tributaries and finding weaknesses in the rock (bottom), the Potomac turns to the southeast, cutting through ridges at Harpers Ferry, South Mountain, and Catoctin Mountain (arrows). Sources: Wikipedia; GMU (2013).

advanced and retreated at least 20 times, with the last glacial episode ending about 15,000 years ago.

Although glaciers never reached our area, they advanced as far south as northeastern Pennsylvania, with two major effects. First, lower ocean levels exposed most of the continental shelf for tens of thousands of years at a time, pushing the shoreline up to 75 miles to the east and vastly expanding the Potomac River drainage. Second, a frigid climate locked the entire watershed in snow and ice for much of the year. The relatively brief seasonal thaws released far greater torrents of water over much shorter timespans than today, amplifying the river's downcutting power for thousands of years at a time.

One result was Chesapeake Bay, the world's largest estuary and a sunken river valley formed by the Susquehanna River during the Pleistocene Epoch, with the Potomac as one of its major tributaries. The tidal Potomac alone, along with its sediments, covers a long and deep Pleistocene river valley. Ancient traces of river valleys at the edge of the continental shelf might date to a time before the Potomac became a tributary of the Susquehanna (fig. 4).

The Fall Line

Another result of continental glaciation in our area, in tandem with gentle regional uplift, was a sharpening of the boundary between the Piedmont and the Coastal Plain. Known as the Fall Line, the boundary is variously drawn at Great Falls, part of a drop in river elevations across the Atlantic seaboard (fig. 5);

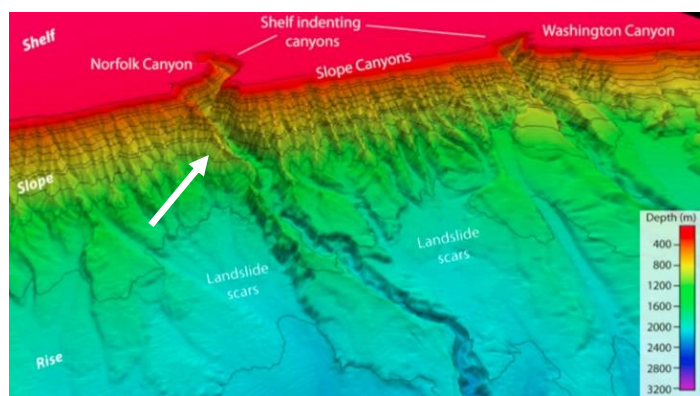


Figure 4—Traces of ancient river valleys at the edge of the continental shelf off Virginia's Eastern Shore, formed when ocean levels were much lower during the Pleistocene Epoch. The Potomac River, joined by the Rappahannock and York Rivers, might have carved Norfolk Canyon (arrow). Source: GMU (2017).

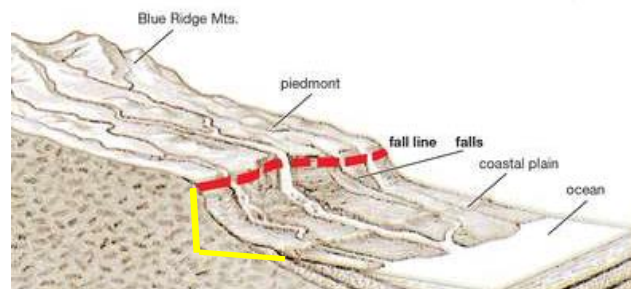


Figure 5—Exaggerated schematic (not to scale) of the Fall Line in our area, a sharp drop along rivers crossing the Piedmont. The Fall Line is actually a zone of falls and rapids (yellow lines) reaching to near sea level, where riverine sediments begin to cover the basement rock.

Source: Encyclopedia Britannica.

at Chain Bridge near Little Falls, the last series of rapids on the Potomac River before tidal influences begin on the Coastal Plain; and at Roosevelt Island, where riverine sediments begin to cover the metamorphic basement rock (in a line traced by Interstate Highway 66 in Virginia). The placements are all correct because the Fall Line is actually a zone (fig. 5).

In school, I learned that the Fall Line marks an escarpment where rivers plunge from the hard metamorphic rock of the Piedmont onto the softer sedimentary rock of the Coastal Plain, wearing it away and forming waterfalls (fig. 5). The Coastal Plain does have sedimentary rock, such as the Aquia sandstone used in some buildings on the National Mall, but it is rare and localized. The Coastal Plain mainly comprises the Potomac Formation; though thick and tightly packed, the Potomac Formation is not rock. Where streams have worn it away in our area, you find metamorphic (never sedimentary) bedrock.

Moreover, despite erosional features such as Great Falls, no escarpment exists (figure 5 is misleading, exaggerated for effect). Instead, Great Falls is at the head of a series of rapids ending at Little Falls, a distance of some 10 miles over various kinds of metamorphic rock. In effect, the falls and rapids comprise a Fall Line zone (fig. 5), a relatively sharp drop in elevation from 129 feet at Great Falls to near sea level below Little Falls.

Most of the drop, about 76 feet, comes at Great Falls itself (47 feet) and along Mather Gorge in the first mile below the falls, with the rest mostly distributed over the remaining distance to Little Falls. The entire

drop reflects a combination of ongoing isostatic uplift in the Piedmont and downcutting during the Pleistocene.

Erodibility?

A variation on the Fall Line explanation I learned in school—erosion-resistant rock bordering more erodible rock—appears in a 1980 USGS publication for visitors to Great Falls titled *The River and the Rocks*:

At Great Falls, the river encounters a series of thick layers of metamorphosed sandstone that are particularly resistant to erosion, and these hard ledges have slowed the progress of valley cutting.

The “metamorphosed sandstone” refers to metagraywacke, one of two major rock types in Mather Gorge. The other is schist, which is indeed downstream from the metagraywacke—and possibly more erodible in places.

But the metagraywacke at Great Falls does not form ledges but rather ribs of rock standing on end, with their bedding at right angles to the flow; uplift during ancient mountain building has exposed the rock’s faults, joints, and fractures to weathering and erosion. Moreover, a geologic map of Great Falls and Mather Gorge shows successive bands of metamorphic rock of various types from north to south (fig. 6): metagraywacke (brown) gives way to mica schist/gneiss (gray), which in turn gives way to metagraywacke interspersed with migmatite (reddish brown), followed by a lens of amphibolite (tan, lower right corner). The Potomac River cuts through all of them with the same apparent ease, usually in straight lines.

So if it isn’t a question of more erodible rock types, then what is it? How did the river do it? ➤

Next: How did the Potomac River find weaknesses in the rock to create Great Falls and Mather Gorge?

Acknowledgment

I am deeply grateful to NVMC members Sue Marcus and Roger Haskins for taking a few hours to walk Great Falls and Mather Gorge with me on the Virginia side, offering information and explanations to help me better understand the geology.

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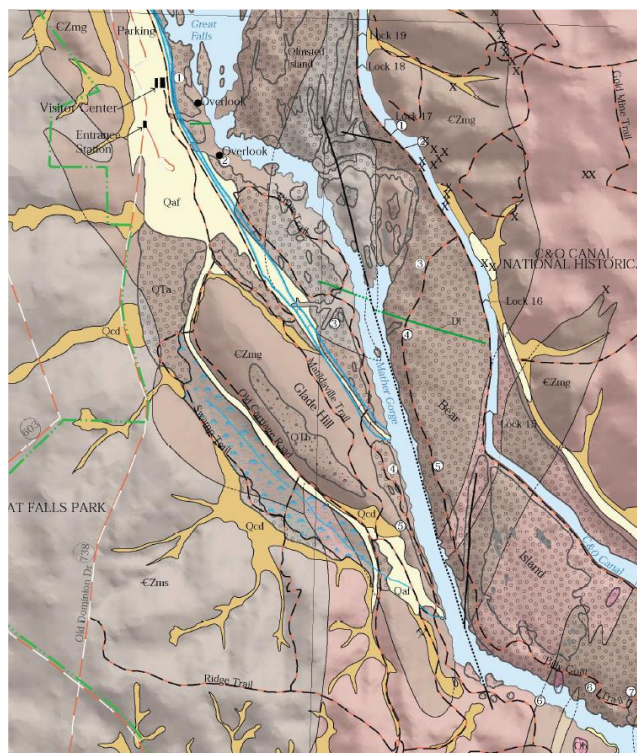


Figure 6—Detail of a geologic map of Mather Gorge on the Potomac River, showing interspersed bands of metamorphic rock of various kinds. The river cuts through them all. Brown (CZmg) = metagraywacke; gray (CZms) = mica schist/gneiss; reddish brown (CZmm) = migmatite; tan (lower right corner) = amphibolite; patterns/yellow/gold = alluvial deposits; C = Cambrian; Z = Proterozoic. Source: Southworth and Fingeret (2000).

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February 2022—Upcoming Events in Our Area/Region (see details below)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2 MSDC mtg	3	4	5
6	7	8	9	10	11	12
13	14 Valentine's Day	15	16	17	18	19
20	21 Presidents Day	22	23 MNCA mtg	24	25	26
27	28 NVMC mtg			<div style="text-align: center; color: red; font-weight: bold;">Disclaimer</div> <p>All meetings/shows are tentative during the coronavirus pandemic, and club meetings might well be remote. Check the website for each organization for more information.</p>		

Event Details

2: Washington, DC—Mineralogical Society of the District of Columbia; info: <http://www.mineralogicalsocietyofdc.org/>.

23: Arlington, VA—Micromineralogists of the National Capital Area; info: <http://www.dcmicrominerals.org/>.

28: Arlington, VA—Northern Virginia Mineral Club; info: <https://www.novamineralclub.org/>.

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The Northern Virginia Mineral Club

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Please send your newsletter articles to:

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SEND YOUR DUES TO:

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OR

Bring your dues to the next meeting.

Dues: Due by January 1 of each year;
\$20 individual, \$25 family, \$6 junior (under 16,
sponsored by an adult member).

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Club purpose: To encourage interest in and learning about geology, mineralogy, lapidary arts, and related sciences. The club is a member of the Eastern Federation of Mineralogical and Lapidary Societies (EFMLS—at <http://www.amfed.org/efmls>) and the American Federation of Mineralogical Societies (AFMS—at <http://www.amfed.org>).

Meetings: At 7:30 p.m. on the fourth Monday of each month (except May and December).* (No meeting in July or August.)

**Changes are announced in the newsletter; we follow the snow schedule of Arlington County schools.*

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