The Northern Virginia Mineral Club Inc

The Mineral Newsletter

Meeting: January 25 Time: 7:30 p.m.

The meeting will be remote due to the coronavirus pandemic. Details to come.

Volume 62, No. 1
January 2021
Explore our website!

January Meeting Program:

Classic Mineral Collection

(details on page X)

In this issue …

Halite cubes
Stassfurt, Saxony-Anhalt, Germany
Source: Wikipedia Photo: Rob Lavinsky

Mineral of the Month
Halite

by Sue Marcus

Halite is salt. Or *a* salt. Halite is sodium chloride (NaCl). Chemists and others recognize other chemical compounds as salts, such as potassium chloride (KCl). We won't go down that trail, leaving it to your curiosity, if you want to pursue it. For the purposes of this column, I will use halite and salt interchangeably.

Nomenclature

In 1847, German mineralogist Ernst Friedrich Glocker began the modern usage of halite for what we call salt (table salt and the mineral halite) from the Greek *hals* plus the mineral ending -*ites*. J.D. Dana finished the modernization of the name by dropping the "s" ending in halites to our current halite.

Halite has attracted attention throughout history. In 1960, Elliott Kimball wrote "The Biography of a Halite Crystal," dedicating it to his wife. Kimball grew, observed, and described the crystal.

I hope that, at some time in your life, you have had a salary. You may know that the word "salary" comes from salt. Salt was so critical to some cultures that it was used as currency—you would be worth your salt, or paid a salary.

Views and Uses Over Time

The ancient Greeks thought that salt in water was spontaneously renewed. They said that salt from lakes was always in the form of grains (not blocks). Pliny mentions mountains in India made of salt. He also mentions places where salt was dug out of the ground (though he thought it was formed by condensation).

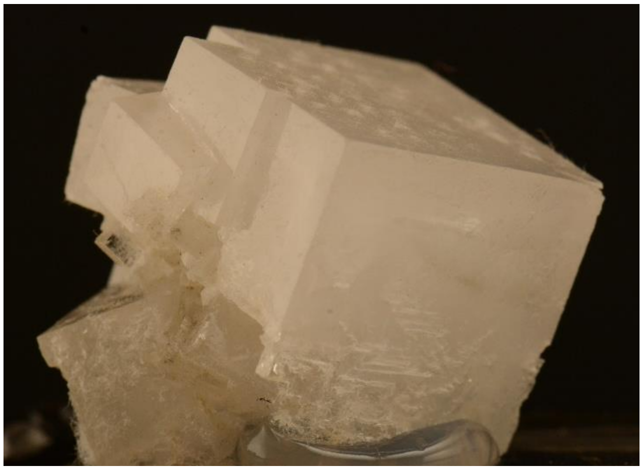
In Arabia, people reportedly built their houses from blocks of salt. The people in Crete and Egypt (among others) made salt by evaporating it from brine in "salt pans" or shallow ponds along the shore. Its use as a preservative was a boon to ancient cultures in separate and diverse parts of the world, allowing them to maintain sources of sustenance when crops or gathered foods were not in season and to preserve meats and fish, which were important sources of protein. Ancient cultures also used salt in cosmetics.

Happy New Year!

Northern Virginia Mineral Club members,

No in-person social events for now!

Halite clusters, Wieliczka Mine, Poland. Photo: Casper Voogt.



Top: *Long history of use with and in foods. Source: University of Minnesota.* **Bottom:** *Halite, Rhodes Salt Marsh, Esmeralda County, Nevada. Photo: Bob Cooke.*

We need salt to greater or lesser extents in our diets too. Halite, in the form of salt used in food, brings a brightness to the flavors or essences in all cuisines. It is used as a preservative, for example in preserving bacon, or added at the last minute.

We use it this time of year to help melt ice. Salt, when mixed with water, lowers the melting point of ice (plain water), so salt helps to melt ice at lower temperatures than normal. If you have ever made ice cream, you used the same principle. If you never made ice cream, give it a try. It is a physics experiment using minerals, it is fun, and you can eat the results.

Plasticity of Salt

Here's a new topic for discussion in a Mineral of the Month column: minerals that move, specifically halite (or salt). Saltwater is less dense than freshwater. Think of the Great Salt Lake or the Dead Sea, where people can float effortlessly because salt aids buoyancy.

Salt is also subject to plastic flow—that is, though solid, it deforms under pressure (fig. 1). When buried deep underground and therefore under pressure and (probably) elevated temperatures, salt deforms. In some large buried salt deposits, a central area will rise slowly (in geologic time) because tectonic forces fracture the overlying rocks, allowing the salt to push upwards as the pressure decreases, forming domes or diapirs. In a diapir, salt forms a streamlined egg shape that eases the upwelling, with a "feeder tube" downward (imagine an egg on a stick).

Geologic Environments

The salt domes and diapirs can lead to geologic environments favorable for oil and gas concentration and sulfur deposits (fig. 1), notably (and economically viable for extraction) along the Gulf Coast in Louisiana and Texas. In Iran, upwelling salt in the arid environment has surfaced and formed salt glaciers, which flow like glaciers of ice (frozen water).

Collectible crystals and economic deposits of halite form under sedimentary conditions when fluids containing sodium and chloride evaporate. Experimentally, halite has been formed from condensation of volcanic gases. Nanoparticle-sized halite has reportedly formed in coral.

The elements of halite are common, so they can erode from many sources. When they collect in a place and evaporate, other evaporative minerals usually form

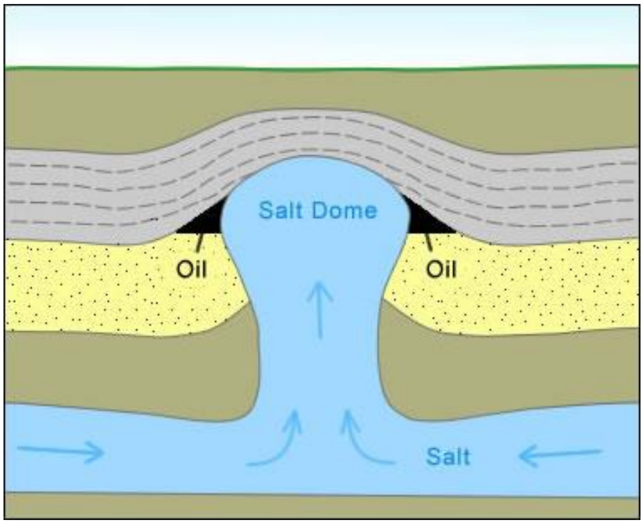


Figure 1—*Salt dome piercing and deforming overlying rock units as the salt is forced into the dome by the weight of adjacent sediments. Source: Geology.com (n.d.).*

first, like gypsum and anhydrite. What is left then evaporates and forms a mineral—often halite.

Because it is so soluble, a brief rainstorm can dissolve halite, which can then form again in dryer weather. Gypsum, anhydrite, sylvite, and other evaporates are hardier; many evaporitive minerals should not be washed in water, and some are soluble in a variety of solvents, so please be careful when cleaning your collection.

Sources

When evaporite deposits are buried through geologic time, they become lithified (rock). Underground mines of potash (with sylvite as the most common ore mineral) or of halite extract these formerly surficial beds of minerals. In the United States, salt is or was mined underground in Michigan, New York, and Kansas. It is extracted from seawater in California and from dry lakes there as well as in Utah and Nevada.

Can you imagine salt mines under lakes? Perhaps you know that they exist under some of the Great Lakes. In fact, the world's largest salt mine is the Goderich Mine beneath Lake Huron, mined from Ontario, Canada.

I hope that we've established that salt is important to people individually and society in general. In Poland, the importance of salt was taken to a magnificent extreme in the Wieliczka Salt Mine, a UNESCO World Heritage Site where an elaborate chapel with crystal chandeliers is dedicated to St. Kinga. The chapel, one of twenty in the mine, includes bas relief and three-dimensional carvings by miners. Upwelling brines at this location have been used since Neolithic times. Underground mining extended from the 1300s to 2007.

Characteristics

Hopper crystals are an interesting form of halite. Hopper crystals look like small cubes inside bigger cubes; they occur when the edges of the crystals form faster than the crystal centers. California and Poland are the primary sources of hopper crystals of halite. Other minerals like galena and gold also form hopper or hopperlike crystals. (The flashy hoppered bismuth crystals you sometimes see are not natural.)

Chapel of St. Kinga, Wieliczka Mine, Poland. Source: Wikipedia; photo: Cezary p.

Halite is usually clear or ranges from white to gray when found naturally, with the lack of transparency caused by sediment, dissolution and recrystallization, or related processes. Natural halite can more rarely be blue-violet, pink, green, or other colors. Let's examine how some of these colors find their way into halite.

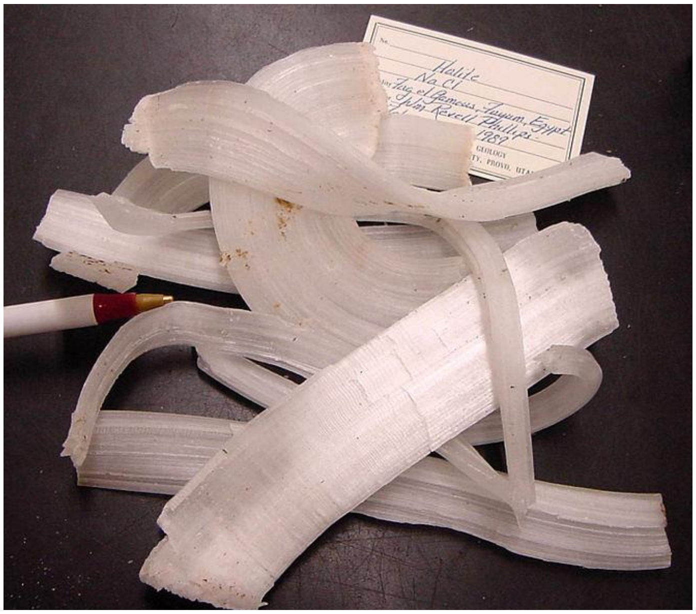
Blue halite can be translucent, with graduated coloration or distinct zoning. Blue halite forms when descending brines knock traces of bromine from the existing halite crystal lattice and replace the lattice sites with metallic sodium. Blue to violet halite crystals from New Mexico, Poland, and Germany are rare and highly prized by collectors. Radiation has been proposed as a cause of the blue color, presumably from displacing atoms in the crystal lattice. Studies of the Klodawa Mine in Poland, as reported by the Ario Salt Company that owns it, determined that irradiation was chemically and physically scientifically unlikely to have caused the naturally blue halite found there.

Poland has a wealth of salt, including various shades of green halite colored by libethenite(?) inclusions. The Sieroszowice Mine produced darker green hoppered halite crystals, with the color caused by copper; other halite was found with red (iron oxide) and black (sulfur, inclusions) colors. Blue halite has been found recently in Turkey, though I've not seen well-formed crystals. Other locales also have small amounts of this unusual form of halite, but the perfect crystals are the rarest and costliest.

Pink halite has been found in the United States at Searles Lake, CA; it is colored by dead bacteria and algae. "Himalayan" pink salt comes from Khewra, Pakistan. Mineral impurities cause the color in Pakistani salt, which can make it unsuitable for use in foods. Marketing rather than scarcity or other characteristics has made this salt more expensive. The Searles Lake salt is geologically young, scraped off drying lakebeds in the desert; by contrast, the salt deposits in Pakistan are geologically ancient, ranging from the Proterozoic Ediacaran Period (about 635 million years ago) to the Cambrian Period (about 525 million years ago). The deposits have been mined since at least the 1200s and possibly earlier.

Halite from Mulhouse in Alsace, France, comes in two very different types, both of which are unusual. One type forms thick, granular, dusky rose pink crusts, with the halite intermixed with sylvite. The other type occurs as unique, narrow, gray-blue fibrous veins.

Halite in various hues, including from Neuhof Fulda, Kassel, Germany (top); Kern County, California (middle); and somewhere in California (bottom). Photos: Bob Cooke.



Unusual halite from Hayum, Egypt.
Source: Wikipedia; photo: Andrew Silver.

Production and Features

In 2020, the U.S. Geological Survey reported that the United States was the world's second largest halite producer, after China. In the United States, halite is extracted by underground mining, dissolution mining (dissolving halite in water, then pumping the saline brines to the surface for evaporation or drying by power dryers), direct brine extraction, and solar evaporation. Highway deicing and the chemical industry use the bulk of halite resources. Despite abundant domestic resources, the United States imports salt from Canada, probably for deicing. Our culinary imports of "boutique" salt are not economically significant.

I would suggest skipping halite as a gem or lapidary material. Although the colors can be lovely, halite's solubility in water would be disastrous. Don't sweat it, you could dissolve your jewelry! Since halite cleaves easily, it would also be difficult to work. My daughter points out, however, that rock candy (sugar) is popular; so if you want a salt fix, you can grow your own.

Not all halite fluoresces, though when it does, it can be spectacular. Halite, nucleating and then growing as crystals on sagebrush from the Salton Sea area in California fluoresces bright orange-red. Manganese and lead are required activators for the Salton Sea material; both must be present for fluorescence to occur. Halite from Poland, Argentina, and Germany also fluoresces under shortwave ultraviolet light in the same color palette, with a few specimens appearing more yellow. Manganese and lead are again the necessary activators for at least some of the Polish fluorescent halite. Under longwave light, specimens from Saskatchewan, Canada, fluoresce blue-white.

Unused underground salt mines are being used for radioactive waste storage in the United States and other countries, although there have been accidents. Thick salt beds can theoretically protect future generations and the environment from radiation by flowing and eroding around the waste deposits, sealing them off. However, this unproven technology is related to dangerous materials that we continue to produce for such purposes as medical and defense uses.

A Caution

We often end our columns, when appropriate, with warnings. Some minerals are radioactive and others can cause health problems when inhaled or touched without proper care and protection.

Halite is benign, right? We all need salt. Well, here comes the warning: salt (halite) can be toxic. Too much can cause blood pressure or heart problems for susceptible individuals. Check with a medical professional for dietary salt/halite/sodium consumption advice.

Yes, common salt can be a problem. Environmentally, as sea levels rise and saltwater encroaches on freshwater sources, water for drinking and irrigation becomes

Halite. Source: Brigham Young University Geology Department; photo: Andrew Silver.

briny and unusable. Soil salinization from groundwater, irrigation water, or erosion of fertilizers can make arable lands too salty to grow crops. Salt may be safer in our collections.

What about smelling salts? They are made of ammonia, usually with fragrance added—not halite, so that's the end of that part of our discussion.

Technical Details

Chemical formula ......NaCl
Crystal form ....Cubic
Hardness 2–2.5
Density ....2.165 g/cm^3 (Measured, NIH)
Color ....Usually colorless or white; more rarely, green, pink, blue, brown, or other colors due to impurities, trace elements, or inclusions, possibly irradiation
Streak ....White
Cleavage ....3 perfect
Fracture ....Conchoidal
Luster ....Vitreous
Note: Highly soluble!

Acknowledgment

Genny Haskins contributed to the article.

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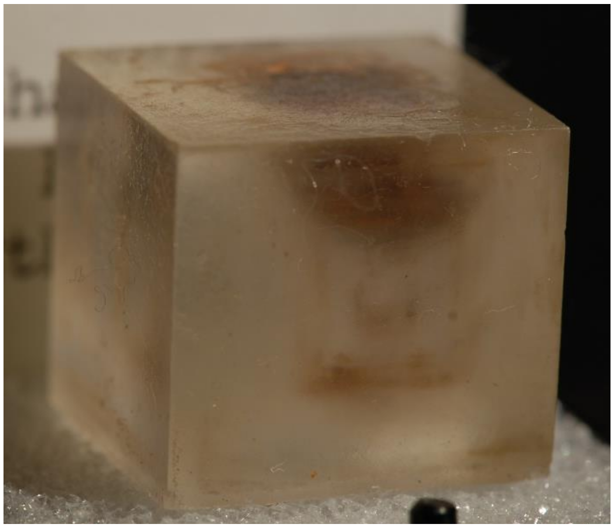

Halite cube, Daketa River (Tug Dashato) Harar, Harari Region, Ethiopia. Photo: Bob Cooke.

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February Mineral of the Month:

Chrysoberyl

See your chrysoberyl photos in print!

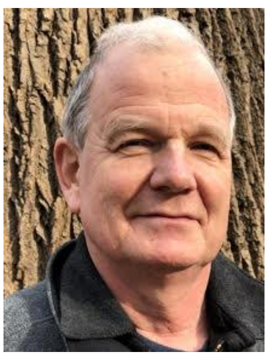
Send your photos with locality descriptions to Hutch Brown at editor@novamineral.club by February 1 for publication in the February NVMC newsletter.

Classic Mineral Collection
January 25 Program

by Sue Marcus, Vice President

Our January program will be presented by Jamison Kilby Brizendine of the Micromineral Club of Cleveland (Ohio). He'll be sharing images of minerals from the collection of a former member of our club, Clarence Domire. Clarence was active in the NVMC, the Micromineralogists of the National Capital Area, and the American Federation of Mineralogical Societies.

We look forward to welcoming a fellow collector from another club—this is an example of technology bringing us new opportunities. Please join us on January 25.



President's Thoughts, Collected

by Tom Burke, President

The 2021 NVMC officers election is finished, and I am pleased to announce that we have a new president and vice president for this year. President-elect is **Tom Kim**, who will take over writing this column beginning with the February issue. As he is a newcomer to the NVMC officer ranks, I'll let him introduce himself:

Tom Kim is a former middle school teacher in Alexandria. He homeschools three children, the oldest of whom, Elijah, is deeply passionate about mineralogy. Together they've been attending club meetings for about two years. He looks forward to ensuring the club's continuity in community, education, and outreach.

Our Vice President-elect is **Sue Marcus**, who surely needs no introduction. As for myself, I am moving into the newly-created position of technical support for the club, and I'll give more details about that in emails to the group. The full slate of club officers can be found on the last page of this newsletter. ⛏

Tom

Membership Fees Due for 2021!

Club membership fees for 2020 are due! The fees are $20 individual and $25 family. For a family membership, please include the form, listing all family members. Send your dues to Treasurer Roger Haskins at 4411 Marsala Glen Way, Fairfax, VA 22033-3136. If you send a check, please make it payable to Northern Virginia Mineral Club.

Share Your Story in the Newsletter!

Club members appreciate reading stories by other club members, whether it's about a trip they took or a specimen they acquired.

Or tell the story of how you got interested in rocks, minerals, or lapidary. Other members are curious!

Editor Hutch Brown can help. You don't have to worry about style, grammar, and so on.

So why not share your story? Just write it up and send it along with a photo of your trip, our specimen, or youself to:

editor@novamineral.club.

Upcoming Minerals of the Month

See your photos in print!

Send your photos with locality descriptions to Hutch Brown at editor@novamineral.club for the following Minerals of the Month:

- Feb 2021............................ chrysoberyl
- Mar 2021........................... elbaite
- Apr 2021............................ prehnite
- May 2021 .... kyanite
- Jun 2021............................ staurolite
- Sep 2021............................ rutile

Geodes Versus Vugs

Editor's note: *The article is adapted from previous issues of other newsletters, most recently* The Backbender's Gazette *(newsletter of the Houston Gem & Mineral Society, Houston, TX), November 2020, p. 7.*

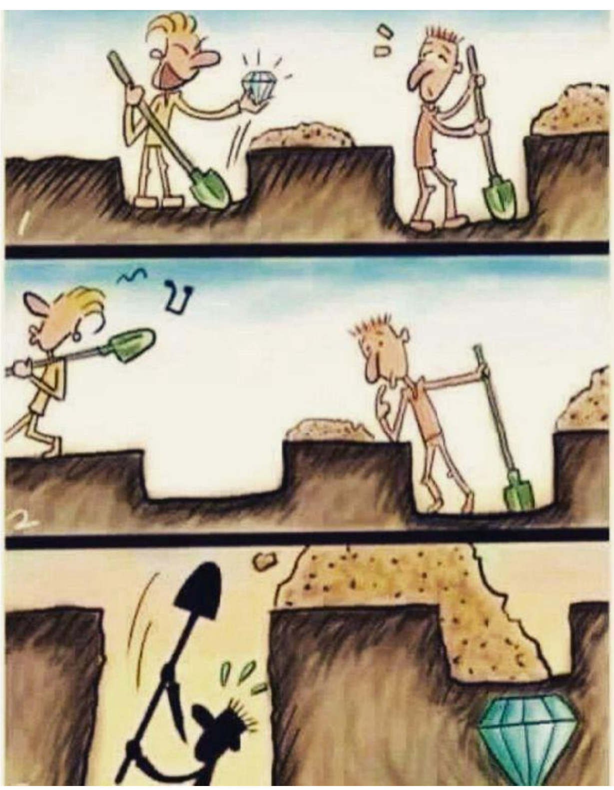
We all know what a geode is—a roughly spherical hollow rock lined with crystals. A vug is a roughly spherical cavity lined with crystals.

But do you know the real difference between the two?

A geode has an outer shell or rind (like a melon) composed of chalcedony, which is harder than the host rock in which the geode formed. When the host rock weathers away, the geode is preserved intact due to its hard shell.

Vugs do not have the protective rinds that geodes do. The crystals in vugs formed within a cavity in the host rock; unlike geode crystals, they are attached to the host rock itself. Therefore, vug crystals are destroyed when the host rock weathers through the cavity.

When weathering exposes a cavity and a rockhound happens to see it, the vug can be chiseled out. If an inch or two of the host rock is left around the cavity, the vug can be removed undamaged.



Poem

Collecting Rocks

Editor's note: *The poem is from* The Conglomerate *(newsletter of the Reno Gem and Mineral Society, Reno, NV), November 2020, p. 4. A club member reported finding it "on a wood plaque in the lapidary shop."*

I think that there shall never be
An ignoramus just like me
Who roams the hills throughout the day
To pick up rocks that do not pay.
For there's one thing I've been told:
I take the rocks and leave the gold.
Over deserts wild or mountains blue
I search for rocks of varied hue.
A hundred pounds or more I pack
With blistered feet and aching back,
And after this is said and done
I cannot name a single one.
I pick up rocks where'er I go;
The reason why I do not know.
For rocks are found by fools like me
Where God intended them to be.

GeoWord of the Day

(from the American Geoscience Institute)

tetrahedral

Having the symmetry or form of a tetrahedron.

(from the *Glossary of Geology*, 5th edition, revised)

Tetrahedrite on chalcopyrite/sphalerite.

Alaska Mining History Tour

Photos by Mike Kaas

***Editor's note:** The photo tour documents the Tour of the Fairbanks Exploration Co. Shops on 17 June 2017 by members of the Mining History Association, including NVMC member Mike Kaas. Some of the photos are shown here. To take the full photo tour, click here.*

Fairbanks became well known for gold dredging, but operating a fleet of dredges would have been impossible without a fully equipped repair shop. The U.S. Smelting Refining and Mining Company, parent company of its Fairbanks Exploration Company, built a machine shop in 1927 to support its dredges in the Fairbanks District.

When operations were shut down in 1964, the company simply closed the shop doors, leaving everything in place. All of the equipment, including industrial machine tools, large-scale welding equipment, and even a blacksmith shop were left in the condition they were in when they turned out the lights. The workers' clothing still hangs in the lockers.

John Reeves purchased the shops and has preserved them. We are grateful to John for affording the Mining History Association the opportunity to visit the shops to see a different facet of historical Alaskan gold mining operations. The site is listed on the National Register of Historic Places but is not normally open to the public.

Mike and Pat Kaas wearing safety gear for descending into one of the Alaska gold mine adits.

Aegirine

Editor's note: *From* Hot Springs Bulletin *(newsletter of the Hot Springs Geology Club, Hot Springs, AR), November/December 2020, p. 8. Thanks to Sue Marcus for the reference!*

Aegirine crystal in feldspar matrix. Photo: Ray Lynch.

Composition: Aegirine is a sodium silicate, $NaFeSi_2O_6$. Here, it is embedded in eroded feldspar, in places coated with aegirine in greenish felted masses.

Environment: Aegirine occurs in rocks that are poor in silica and with low-silica equivalents of feldspar—the feldspathoids, like nepheline and leucite.

Crystal description: Recognizable only when crystallized, aegirine usually occurs in monoclinic, prismatic, embedded crystals several inches long terminated by steep pyramids. Also in fibrous masses.

Physical properties: Black, brown, green on thin edges; glass luster, hardenss 6–6.5; specific gravity 3.4–3.5; fracture uneven; cleavage easy prismatic; brittle; translucent on thin edges.

Occurrence: Aegirine is common in high-soda, low-silica rocks such as at Magnet Cove, AR (the outstanding U.S. locality), where slender crystals several inches in length are abundant. Many samples were sent to Europe before it was properly identified in 1850. People thought it was black tourmaline!

The Rocks Beneath Our Feet

Columnar Metabasalt in the Blue Ridge

by Hutch Brown

Last summer, I took a hike with my family in the Blue Ridge Mountains near the northern entrance to Skyline Drive in Shenandoah National Park. We started at a roadside parking lot on the eastern side of the Blue Ridge and took the Appalachian Trail, climbing a mile or two up to a divide over to the western side.

Our destination was one of the few distinctive geologic formations in our area (fig. 1): a little-known display of columnar basalt on a summit called Compton Peak.

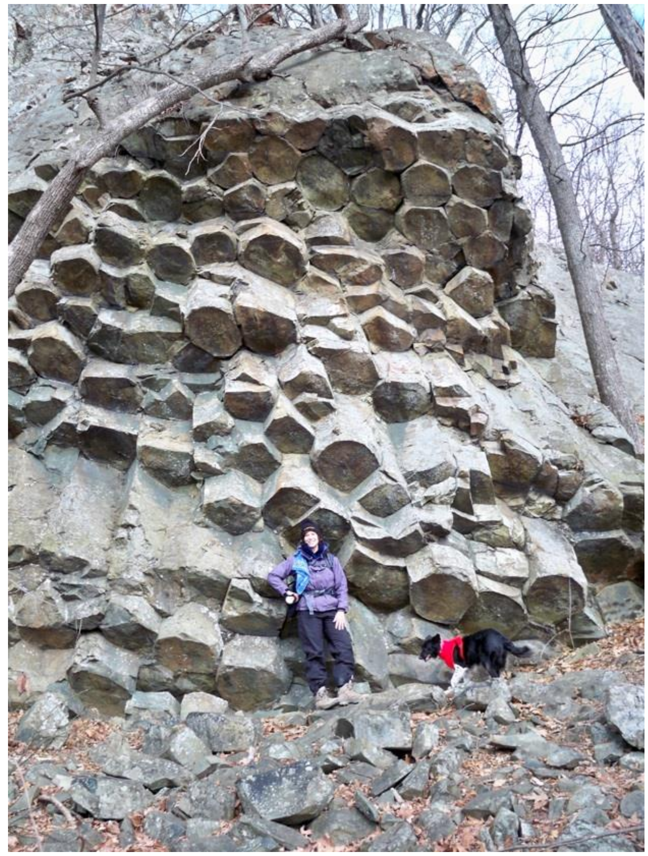


Figure 1—*Columnar metabasalt at Compton Peak, Blue Ridge Mountains. Source: Bentley (2011b); photo: Tom Johnson.*

The rocks in our area are generally old; some (such as at Old Rag in the Blue Ridge) are more than a billion years in age. Rocks that old have usually been through multiple mountain-building events. Compressed, fractured, folded, and metamorphosed, they often bear little semblance to their original appearance. The Compton Peak site is an exception.

It was partly cloudy on the day of our trip, and clouds hugged the Blue Ridge, which captures warm summer air from the West and wrings it out as the air rises and cools. While hiking, we ran into fog and a light but steady drizzle. The rain and mist worsened my photography, resulting in blurry images. So I borrowed an illustration from a blog by Professor Callan Bentley of Piedmont Virginia Community College (fig. 1).

Like most geologic features in our area, the Blue Ridge Province trends from northeast to southwest (fig. 2, blue). The province is about 20 miles wide, with ridges on both sides. In Virginia, the northwestern ridge forms a line of low peaks called the Blue Ridge Mountains; the southeastern side is a series of low ridges with various names, such as Catoctin Mountain in Maryland and Bull Run Mountain in Virginia.

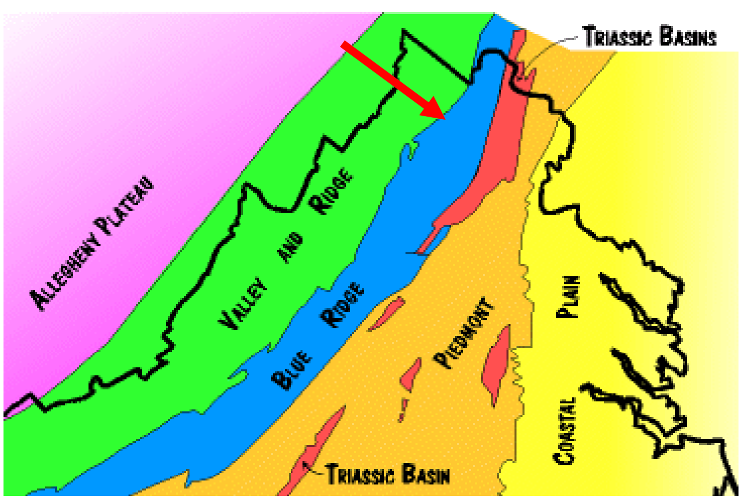


Figure 2—*Geologic provinces in Virginia. The Blue Ridge Province (blue), like most other formations, trends from northeast to southwest. Arrow shows approximate location of Compton Peak. Source: Fichter and Baedke (1999).*

The Blue Ridge rock types vary in appearance, location, and geology. We were on the western edge of the province (fig. 2, arrow), where much of the bedrock is Catoctin greenstone. As the name suggests, the rock is crystalline, very fine grained, and gray-green in color. At Compton Peak, you can take a side trail downhill to a spot where the greenstone is weathered away to expose hexagonal columns (fig. 1).

Where did the Catoctin greenstone come from and why does it form columns?

Building Blocks of the Blue Ridge

Geologists trace the geologic origins of our area to ancient mountain-building events known collectively as the Grenville Orogeny. From about 1.3 billion to 1 billion years ago, proto-North America collided with other contents to form the supercontinent Rodinia. The Grenville granitoids still underlie much of our area.

About 700 million years ago, the continental crust began to stretch and dome under a magma plume (fig. 3), exposing the granite to erosion. The resulting sediments formed the siltstones, sandstones, and conglomerates of the Swift Run and Lynchburg Formations. The rising magma also left underground plutons of granite, exposed today in parts of the Blue Ridge.

From about 690 million to 570 million years ago, the subcontinental components of Rodinia began to break apart as the upwelling magma finally surfaced (fig. 3). Great volcanoes spewed huge quantities of ash over large areas. Litified, the ash is visible today as metarhyolite across parts of western Virginia; for example, it forms much of the bedrock near Mount Rodgers, the highest peak in the Blue Ridge.

The upwelling magma also poured lava across enormous areas; the molten rock cooled into layers of basalt about 2,000 feet thick. The basalts covered the older Swift Run and Lynchburg rocks even as the sinking bedrock formed a trench that filled with seawater (fig. 3), the beginnings of the Iapetan Ocean.

As the continents spread apart and the Iapetan Ocean grew, the basalts were covered by marine sands and muds that hardened into alternating layers of sandstone and siltstone—the Weverton, Harpers, and Antietam Formations (fig. 4). By about 500 million years ago, the Iapetan Ocean covered most of our area, leaving shells and other marine deposits that hardened into limestone, the Tomstown Formation.

In short, even though Rodinia broke apart, the Grenville granitoids remained as bedrock, though now including younger granites and diabase dikes (fig. 4). On top of the Grenville rocks came a series of deposits:

- the Swift Run and Lynchburg sands and gravels;
- the lava flows that hardened into Catoctin basalts;
- the Weverton beach sands;
- the Harpers lagoon muds; and
- the Antietam offshore sands.

The Weverton, Harpers, and Antietam Formations are known as the Chilhowee Group. Together with the Catoctin Formation, the Chilhowee rocks form the capstone for today's Blue Ridge geologic province.

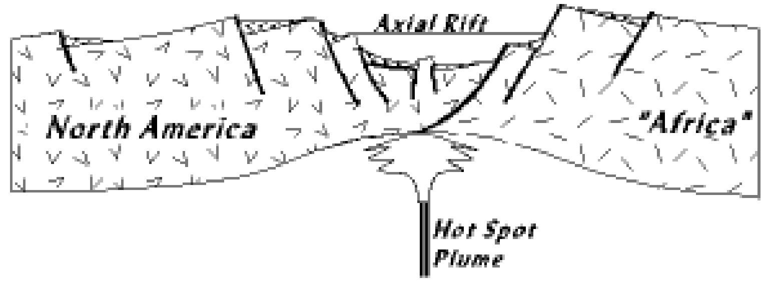


Figure 3—*Breakup of Rodinia about 600 million years ago, with proto-Africa splitting away from proto-North America. Magma rises as the crust domes and thins, forming a hotspot and pouring lava over vast areas. The central ("axial") rift causes faulting on both sides, with great blocks of crust sliding down and forming ridges and valleys that fill with basalt, volcanic ash, and eroding sediments. The sinking central bedrock is covered by seawater as an ocean begins to form in the widening rift between the continents. Source: Fichter and Baedke (1999).*

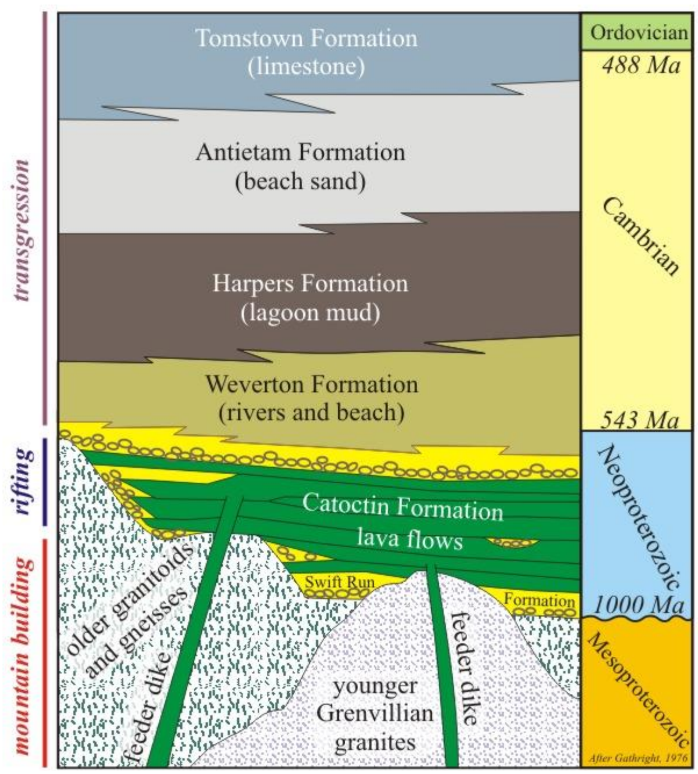


Figure 4—*Some of the younger granitic rocks in the Blue Ridge formed from plumes of rising magma that cooled underground as the supercontinent of Rodinia broke up. Rising magma left lava flows that hardened into layers of basalt (green). As the continents spread, sediments of sand and silt hardened into rock, as did the overlying marine sediments from the Iapetan Ocean. Source: Bentley (2014).*

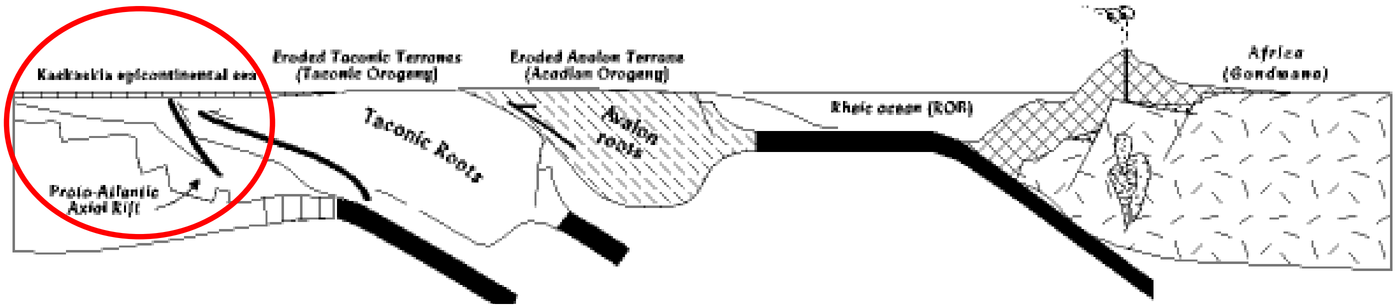


Figure 5—*Tectonic calm about 350–320 million years ago as proto-Afica (right) closes the ocean remnant and approaches proto-North America. The roots of the Taconic and Acadian (or Avalon) Terranes are sutured onto proto-North America. The Grenville bedrock, Catoctin basalt, and Chilhowee Group (circled) are covered by a shallow inland sea (the Kaskasia). Source: Fichter and Baedke (1999).*

Mountain Building

Tectonic calm followed until about 450 million years ago, when a volcanic island arc known as the Taconic Terrane slammed into proto-North America, followed about 50 million years later by a second terrane. Each collision formed a mountain chain that weathered away within a few tens of millions of years, leaving the terrane sutured onto the continent (fig. 5). Today, the Taconic and Avalon Terranes form the roots of our Piedmont and Coastal Plain geologic provinces.

By about 350 million years ago, the Iapetan Ocean was closing as proto-Africa approached proto-North America (fig. 5). Our area was a flat and featureless plain, much like the Coastal Plain today, with a vast inland sea called Kaskasia, which covered today's Blue Ridge rocks.

About 320 million years ago, the ocean remnant completely closed as proto-Africa (then part of a larger continent called Gondwana) collided with proto-North America (fig. 6), contributing to the formation of the supercontinent Pangaea. The dipping subduction zone acted as a ramp, allowing proto-Africa to slide up over proto-North America. No one knows how far inland it went, but possibly as far as the Allegheny Front (fig. 2, purple), where the impacts abruptly end.

The overlying mountains have long since eroded away, leaving no trace of proto-Africa but exposing its tremendous impacts on the underlying rocks. The enormous weight of Gondwana and the terrific heat and pressure did more than just deform the underlying rocks. The force of the collision actually displaced many native rocks, pushing them into the spots we see them in today. In the process, the orogeny shaped three of our geologic provinces: the Piedmont, Blue Ridge, and Valley and Ridge (fig. 2).

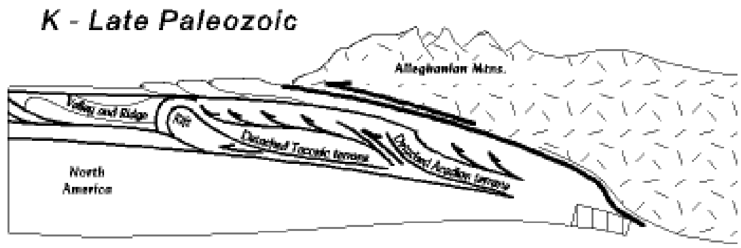


Figure 6—*The Alleghanian orogeny, about 320 million years ago (during the late Paleozoic Era). As proto-Africa rides up over proto-North America, massive thrust faulting pushes the Taconic and Acadian terranes and some of the Grenville basement rocks westward while folding the flat sedimentary rocks beyond. Source: Fichter and Baedke (1999).*

Old sutures associated with the terranes and old faults along the ancient continental edge caused large sheets of rock to detach and slide westward along great, nearly horizontal thrust faults (fig. 6). In addition, rock layers that had been flat were crumpled together like folds in a rug, with downturns alternating with upturns. Geologists call them synclines and anticlines.

Blue Ridge Anticline

The Alleghanian Orogeny lasted tens of millions of years, forming a mountain range as high as the Himalayas today. The tremendous heat and pressure folded and faulted the Blue Ridge basalts and the overlying Chilhowee rocks while transforming them into metabasalts, quartzites, and phyllites. In the process of metamorphism, the tremendous heat and pressure altered the chemical composition of the basalt. Minerals in the original igneous rock—olivine, pyroxene, and plagioclase—changed into chlorite, actinolite, and epidote, giving the Catoctin greenstone its distinctive greenish color.

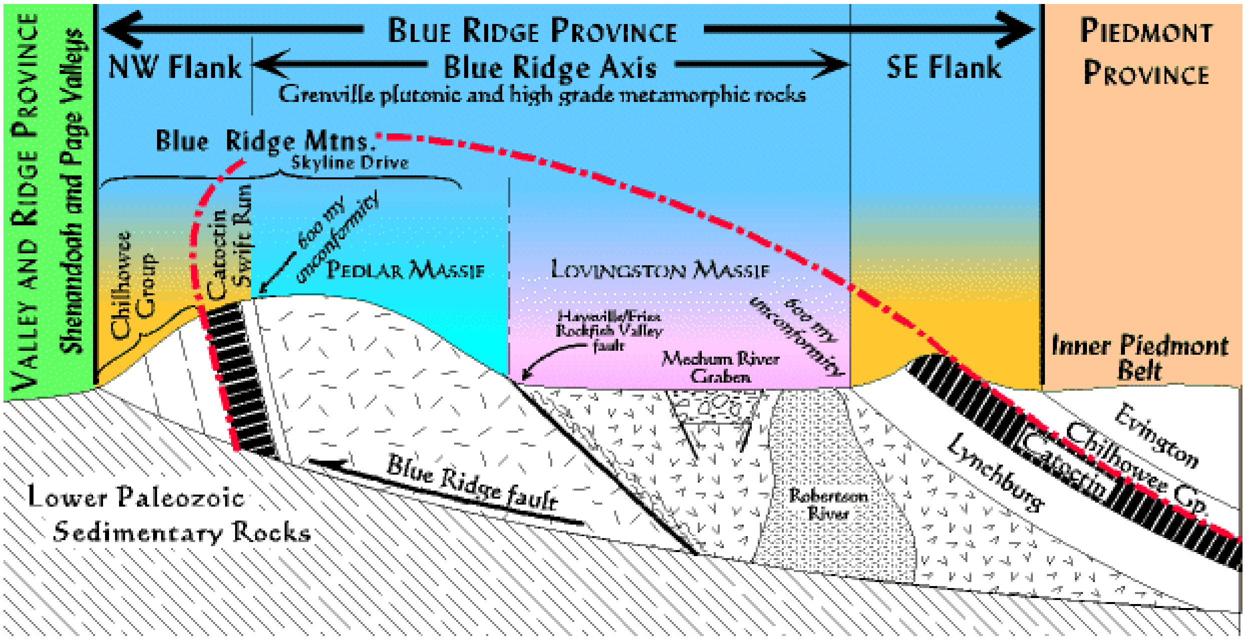


Figure 7—*The Blue Ridge Province, a giant overturned anticline, most of it eroded away. The anticline core is made up of Grenville basement rocks, intrusive granitoids, and diabase dikes. The eastern and western limbs largely mirror each other, comprising the Lynchburg and Swift Run rocks and the (originally) overlying Catoctin greenstone and Chilhowee rocks. The anticline was probably buried under the ancient Alleghanian Mountains, long since gone. Erosion has breached the anticline, leaving a low eastern ridge and a higher complex of granitic and greenstone ridges and peaks in the west, now known as the Blue Ridge Mountains. Source: Fichter and Baedke (1999).*

To fully understand what happened, you need to know a syncline from an anticline and how they fit together. *In Suspect Terrain* (1983), John McPhee's classic book about the geology of the Northeast and Upper Midwest, explains it well:

> *When rock is compressed and folded, the folds are anticlines and synclines. They are much like the components of the letter S. Roll an S forward on its nose and you have to the left a syncline and to the right an anticline. Each is a part of the other.*

Before the Alleghanian Orogeny, the Blue Ridge rocks (Lynchburg, Swift Run, Catoctin, and Chilhowee) formed a relatively flat sequence of layers resting on the Grenville bedrock (fig. 4). The great Alleghanian rock train transported them many miles inland and buckled them all into a giant anticline about 20 miles across (fig. 7). The leading edge of the anticline was overturned, resting on the edge of younger rocks (limestones and dolomites) forming synclines to the west.

The anticline was breached long ago by erosion, but you can still reconstruct it (fig. 7, red line). It probably lay at the heart of a mountain range more than 30,000 feet high, long since gone. The core of the anticline was the Grenville basement rock, along with intrusive granites and diabase dikes (figs. 4, 7). Next came the Lynchburg and Swift Run Formations, topped by the Catoctin basalts, now a greenish metabasalt in layers hundreds of feet thick. Finally came the Chilhowee Group—the tough white Weverton quartzite, the Harper's phyllite, and the Antietam quartzite.

Most of the anticline has weathered away, leaving low ridges of Catoctin greenstone and Chilhowee rocks in the east (fig. 7), including Catoctin Mountain and Bull Run Mountain; higher ridges and peaks of granite, metarhyolite, and Catoctin greenstone in the west (the Blue Ridge Mountains proper); and, in between, hills and outcrops of the Grenville granites and gneisses.

Compton Peak

Compton Peak (elevation 2,910 feet) lies in the northern Blue Ridge Mountains. It has a bedrock of granodiorite gneiss (a Grenville granitoid) overlain by Catoctin greenstone. Last summer, as we hiked up to the Compton divide along the crest of the Blue Ridge,

Catoctin greenstone outcrops near Compton Peak showing signs of columnar basalt, such as flat angular surfaces (top) and parallel vertical joints (bottom). Photos: Hutch Brown.

Compton Peak columnar metabasalt, with the author's son Alex for scale (blur caused by rain and mist). Note the uptilt. Photo: Hutch Brown.

we passed outcrops of metabasalt with signs of columnar formations, such as parallel angular surfaces and evenly spaced vertical joints.

The reason for the columns has to do with physics. The Cambrian lava floods spread at about the same depths over relatively flat bedrock, cooling evenly from the surface down. As the rock cooled, it cracked at the surface to relieve stress.

For reasons best known to physicists, cracking in a hexagonal pattern (with regular 120-degree angles) relieves the maximum stress per unit of crack. You can see it in drying mud; the same hexagonal patterns are common in mudstones from ancient lakes and lagoons. After the cracking began in the cooling lava, the vertical stress gradients in the rock kept the cracks going down through the flow, forming hexagonal columns that can be extremely long.

You can find unmistakable signs of columnar basalt in many parts of the Blue Ridge Province across multiple states. Elsewhere, however, the columnar basalt is mostly deformed, without the relatively even hexagonal shapes you see at Compton Peak. Despite all the pressures associated with Alleghanian mountain building—which clearly uptilted the greenstone at Compton Peak (see above)—the columns must have moved in tandem rather than being compressed or pulled apart. The formation thereby stayed relatively intact.

A Caution

The columnar metabasalt at Compton Peak is well worth seeing, but not if it is raining. The Appalachian Trail is fine in any weather, but the side trail down to the hexagonal columns, though short, is steep and can be dangerous, especially if the rocks and soils are slick with rain. Even in dry weather, you have to be careful and wear good hiking boots.

If you go, another side trail from the divide (this one a short and easy hike) leads you to a pair of overlooks with great views of ridges and peaks on the Shenandoah Valley side of the Blue Ridge.

It's easy to get there and only about 90 minutes away from the metropolitan area by car. You take Skyline Drive south from the north entrance (near Front Royal) to the Compton Gap parking lot at mile marker 10.4. The hike is on the Appalachian Trail for about 2.5 miles (round trip), with an elevation gain of about 835 feet. The trail difficulty is rated as moderate.

Note

Professor Callan Bentley of Piedmont Virginia Community College has a wonderful set of photos of the Compton Peak columnar basalt taken on a beautiful day. He annotated some of them, helping you understand what you are looking at. If you can't make it there yourself, you can check out the photos on his Mountain Beltway blog (see the first source below).

Acknowledgment

Thanks to Sue Marcus for reviewing and improving the article. I am responsible for any errors.

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Compton Peak columnar metabasalt, looking up from below. Source: Bentley (2011a).

AFMS Convention Canceled

Due to COVID restrictions in the township of Sandy, UT, the AFMS has canceled its annual convention scheduled for April 21–25. The township will not allow the hosting club to hold the joint convention with the Rocky Mountain Federation Mineral Society. For more details, check the AFMS website at www.amfed.org.

Club Rockhound of the Year

by Ellery Borow

Editor's note: *The article is adapted from* EFMLS News *(December 2020), p. 4.*

Every club I have ever visited has many dedicated volunteers who help with everything. Clubs don't have paid positions. Everyone is a volunteer: every officer, every editor, every committee, every show chair, every webmaster. The Club Rockhound of the Year (CROY) program encourages recognition of those volunteers and the wonderful work they do.

Some editors serve for decades, as do some presidents, vice presidents, treasurers, and secretaries. Field trip chairs might serve for decades and show chairs do as well. But it does not always take time in grade to be a good, dedicated CROY honoree. A person can be the best refreshment chair for a whole year. A new field trip chair might arrange a trip to a brandnew pit. A just-joined secretary might take the best notes ever. It's up to the club to decide who deserves to be recognized and what selection criteria to use. It need not be by committee, by vote, or by executive board decision. The club alone decides who and how.

The difficulty often comes from having so many deserving of recognition. But you'll figure it out. I know you will choose well, especially with so many good people to choose from—and you can always choose another honoree next year.

The CROY program is available to all EFMLS clubs as a way to recognize members who go above and beyond in service to their club. Here is how it works:

- Your club makes its selection.
- You write a brief (perhaps 70-word) description of the member's dedication and send it to me.
- We take your writeup and place it in the pages of the AFMS and EFMLS newsletters to honor your member's dedicated service and let other clubs share in the honoring.

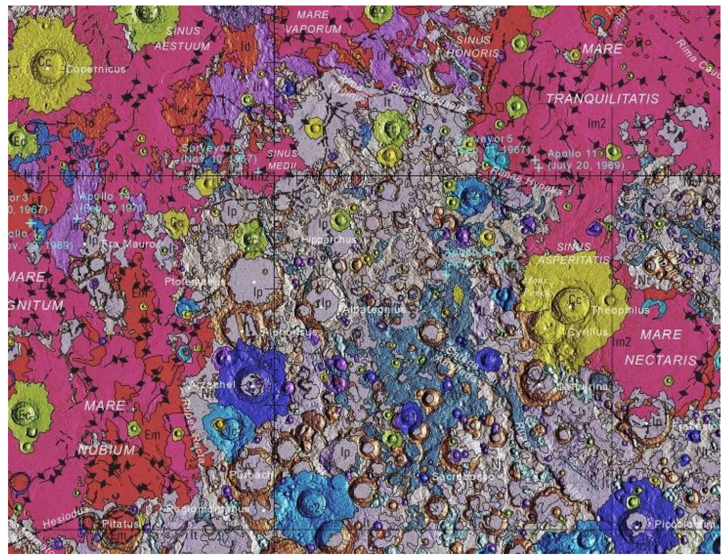
There are a few rules:

1. Your club may submit only one name per year (or two for a couple).
2. Your club may also nominate a junior club member.
3. Anyone in your club may nominate someone.

Easy, right?

Let's get the word out. We hope to hear from you, now that we're ready for your 2021 honoree(s)! Let's work together and help honor your dedicated members. You can reach me at rocknellery@fairpoint.com or at P.O. Box 47, Waterville, ME 04903-0047.

Thanks! Please stay well and be safe! ⛏



A New Map Shows the Moon as It's Never Been Seen

by Lila Nargi

Editor's note: *The article is from* The Washington Post *(June 1, 2020). Thanks to Sue Marcus for the reference!*

In the year 2024, NASA plans to send astronauts 239,000 miles to the moon. It will be the first time since 1972 that humans have touched down on Earth's only natural satellite. The mission will also include the first woman to travel to the moon.

NASA will have a cool new tool to help it with this mission: the Unified Geologic Map of the Moon. The map shows physical features, such as the height of mountains and the depth of valleys. The U.S. Geological Survey calls it the "definitive blueprint of the moon's surface geology." … *Read more*. ⛏

January 2021—Upcoming Events in Our Area/Region (see details below)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1 New Year's Day	2
3	4	5	6 MSDC mtg, Washington, DC	7	8	9
10	11 GLMSMC mtg, Rock-ville, MD	12	13	14	15	16
17	18 Martin Luther King Day	19	20	21	22	23
24	25 NVMC mtg, Arlington, VA	26	27 MNCA mtg, Arlington, VA	28	29	30

Event Details

2: Mineralogical Society of the District of Columbia—meetings via Zoom until further notice; info: http://www.mineralogicalsocietyofdc.org/.

8: Gem, Lapidary, and Mineral Society of Montgomery County—meetings via Zoom until further notice; info: https://www.glmsmc.com/.

14: Northern Virginia Mineral Club—meetings via Zoom until further notice; info: https://www.novamineralclub.org/.

16: Micromineralogists of the National Capital Area—meetings via Zoom until further notice; info: http://www.dcmicrominerals.org/.

Disclaimer

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.

Hutch Brown, Editor
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Mineral of the Month: Halite

2021 Club Officers

President: Tom Kim
president@novamineral.club
Vice President: Sue Marcus
vicepresident@novamineral.club
Secretary: David MacLean
secretary@novamineral.club
Treasurer: Roger Haskins
treasurer@novamineral.club
Communications: Ti Meredith
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Editor: Hutch Brown
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Field Trip Chair: Vacant
Greeter/Door Prizes: Ti Meredith
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Show Chair: Tom Taaffe
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PLEASE VISIT OUR WEBSITE AT:
http://www.novamineralclub.org

The Northern Virginia Mineral Club

Visitors are always welcome at our club meetings!

Please send your newsletter articles to:
hutchbrown41@gmail.com

RENEW YOUR MEMBERSHIP!

SEND YOUR DUES TO:
Roger Haskins, Treasurer, NVMC
4411 Marsala Glen Way, Fairfax, VA 22033-3136

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

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 7:45 p.m. on the fourth Monday of each month (except May and December)* at **Long Branch Nature Center**, 625 Carlin Springs Road, Arlington, VA. (No meeting in July and August.)

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