THE NORTHERN VIRGINIA MINERAL CLUB INC

The Mineral Newsletter

Meeting: June 23 Time: 7:45–9:00 p.m.

Long Branch Nature Center, 625 S. Carlin Springs Rd. Arlington, VA 22204

Club Member Show and Tell
June 23 Meeting

Here's your opportunity to share with other club members! Maybe you have a mineral you want to show—or maybe you just need help identifying a rock. Or maybe you have a collecting adventure you'd like to share.

This meeting is designed for fellowship with like-minded rockhounds. Mike Smith will demonstrate cabochons, Kathy Hrechka will display micromounting, … and you can feature any aspect of our hobby you like!

Refreshments and light snacks will be provided. Remember to wear your name tag, if you have one. **This is our last club meeting until September!**

Previous Meeting Minutes
May 19, 2014

by Ti Meredith, Secretary

President Wayne Sukow called the meeting to order at 7:50 p.m.

Wayne welcomed a new member, Kari Griffin from Leesburg, who likes meteorites, fossils, and minerals. He joined the NVMC to find out more about rocks and minerals and to talk with people who have the same interests.

The club recognized past presidents in attendance, including Kathy Hrechka, Rick Reiber, Berry Remer, and Wayne Sukow.

Volume 55, No. 6
June 2014
You can explore our club Website at
http://www.novamineralclub.org/

Northern Virginia Mineral Club members,

Please join board members for dinner at the Olive Garden at 6 p.m.

Olive Garden, Baileys Cross Roads (across from Skyline Towers), 3548 South Jefferson St. (intersecting Leesburg Pike), Falls Church, VA
Phone: (703) 671-7507

Reservations are under Kathy Hrechka, Vice President, NVMC. Please RSVP to my cell at (703) 407-5393 or kshrechka@msn.com.

In this issue …

The Prez Sez

IS ANYBODY OUT THERE? DOES ANYONE CARE? There's nobody out there—or if there is, nobody cares. Well, I'll try again, maybe June will be different …

ENJOY and VOLUNTEER!

Enjoy the Summer and don't worry about missing the NVMC Meeting.
Enjoy the Summer and collecting minerals.
Enjoy the Summer and attending mineral shows.
Enjoy the Summer and reflect on your mineral hobby.
Enjoy the Summer and come back to NVMC refreshed.
Volunteer to be nominated for an NVMC office—lead!
Volunteer to help at the 2014 NVMC show.
Volunteer to share your expertise and give a club program.
Volunteer to be an auctioneer at the NVMC auctions.
Volunteer to be a mentor for a new member of teacher

YOUR VOLUNTEER PREZ ENJOYING VOLUNTEERING … Wayne

News and Announcements

Jim Kostka announced that the November GMU club show is on track, and he invited club members to take show announcements with coupons. Our best advertisement is word of mouth and posting the coupons in public places like Starbucks, Giant, and community centers. We have two volunteers so far and need more.

Tony Peruzzi announced that the Boy Scouts will participate in the November show. They will host activities that will help them earn a Boy Scout STEM award.

This month, Ti Meredith and Rick Reiber donated the door prizes. Door prizes winner included Tom Benedict, Carolyn Cooke, Kathy Hrechka,

Door prizes at the May club meeting included a red rock salt lamp (at the top). Photo: Sheryl Sims.

2014 EFMLS Bulletin Editors' Award Contest
Congratulations, NVMC Award Winners!

New Editor
Third Place: Hutch Brown

Educational Articles
Fifth Place: David MacLean, "The Hadean Eon, the Earth's First Chapter"

Seventh Place: Kathy Hrechka, "Lake Superior Agates"

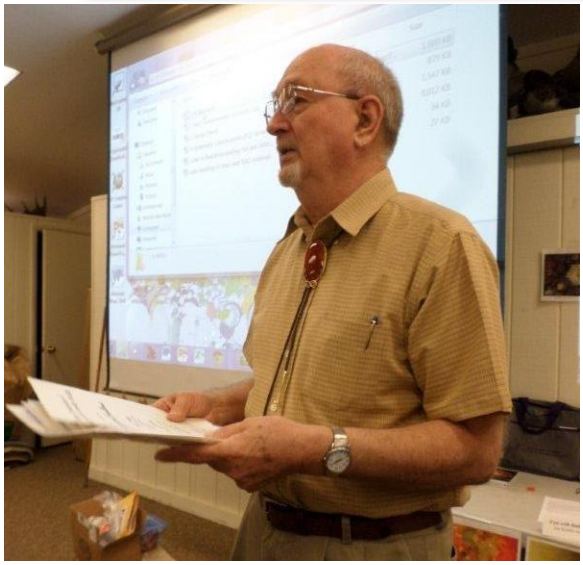
Nontechnical Articles
Honorable Mention: Hutch Brown, "Rocks of Old Rag Mountain"

Nontechnical Articles (cont.)
Honorable Mention: Kathy Hrechka, "The Lost World of James Smithson"

Honorable Mention: Sue Marcus, "Minerals in the Land of Oz"

Written Features
Third Place: Sue Marcus, "Opportunities For Self-Collecting: Where Can You Go?"

Fourth Place: Kathy Hrechka, "Happy 94th Birthday Fred Schaefermeyer 1/28/19"



President Wayne Sukow announcing EFMLS bulletin contest awards and editor Hutch Brown presenting awards to Kathy Hrechka and David MacLean. Photos: Sheryl Sims.

Thanks for contributing to our newsletter!

Ti Meredith, Tony Petruzzi, Barry Remer, and Sheryl Sims.

Wayne announced club winners in the 2014 EFMLS Bulletin Editors' Awards Contest (based on submissions in 2013). He presented Hutch Brown with an award as newsletter editor and announced an award for Casper Voogt (who was not present) for his work as club Webmaster. Hutch went on to announce awards and honorable mentions for articles written by Kathy Hrechka, Sue Marcus, and Dave MacLean.

New Business

Wayne invited club members to join a search committee to nominate club officers for 2015. He will bring it up again at the June club meeting.

A question was asked about Wildacres. Members who have been there described it as a 6,500-acre retreat in the North Carolina Blue Ridge. The EFMLS hosts a week of classes there in spring and fall; for more information on this fall's program, see the article below.

Presentation

Jim Kostka gave an informative presentation on radiation and radioactivity in minerals and rocks. Jim displayed a wealth of related materials, including Geiger counters, radioactive objects, and various photos and publications.

Jim works for a company that uses scanning technology to find cancer in patients. He presented the physics of radiation, noting that radiation is all around us; in fact, our bodies are exposed to small amounts of radiation every day.

Jim concluded his presentation by noting that it was only part 1. He will present part 2 at a future club meeting, focusing more on actual radioactivity in rocks and minerals.

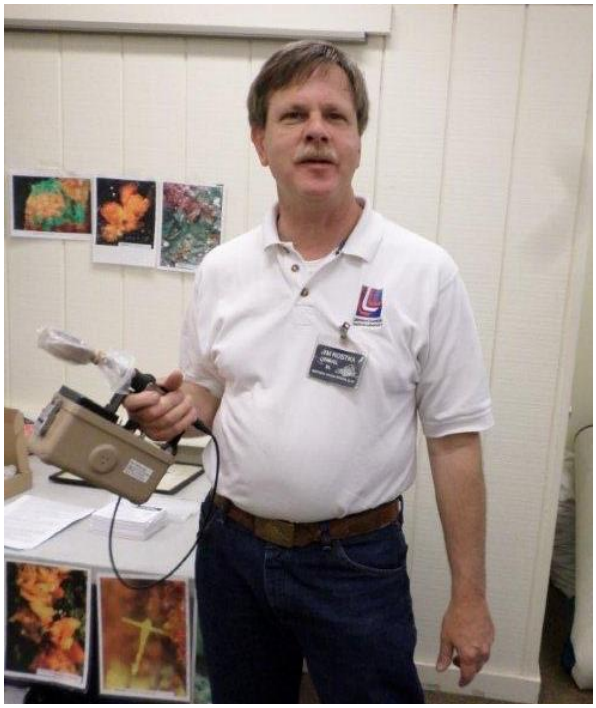
Jim's presentation referred to several Websites:

http://www.iba-worldwide.com/gateway

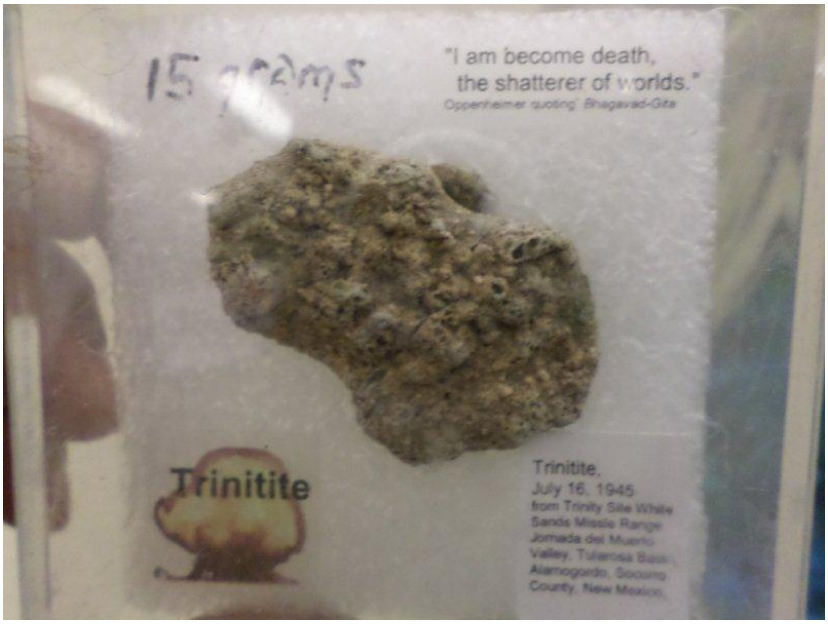
http://www.theodoregray.com?PeriodicTable/Elements/09/index.s7.thml

http://chemistry.about.com/od/elementatacts/a/uranium.htm

Conrad Smith closed the meeting by thanking the club for contributing funds to help him and his high school team go to the national Science Olympiad competition in Orlando, FL. Some 60 teams from every state participated in the all-day event. Conrad's team did not do as well as he had hoped, but he and his fellow students learned a lot from their experiences. His mother Linda pointed out that the team was relatively new and did quite well for a team so young.



Jim Kostka demonstrating a Geiger counter before his presentation. All photos: Sheryl Sims.



At the club meeting, there was lots to see related to radiation and radioactivity in various materials, including radioactive trinitite from the White Sands Missile Range where the atomic bomb was first tested.

Are You Interested in Nature?

From the Smithsonian Institution Museum of Natural History—thanks to Sue Marcus and Kathy Hrechka!

Are you curious? Then Q?rius (pronounced curious) is the place for you.

Join our dedicated volunteer team in encouraging visitors to explore fun, experimental, and creative activities. Q?rius was created for 10- to 18-year-olds to deepen their interest in nature, culture, and science. Through real-world interactions with scientists and tactile experiences with thousands of authentic objects, visitors can unleash their curiosity, with surprising results.

We provide the training, you bring the passion. Training includes:

- Discovering behind-the-scenes scientific research;
- Exploring activity content;
- Understanding the museum education approach;
- Working with multigenerational visitors; and
- Examining scientist communication techniques.

For more information and an application form, contact Q?rius Volunteer Coordinator Jill Sanderson at sandersonj@si.edu or call 202-633-2122.

Murphy's Law: If Anything Can Go Wrong …

Editor's note: The piece is adapted from Mineral Humor, *a Website maintained by Larry Rush at http://mineralhumor.homestead.com/.*

Laws of Equipment

A dropped tool will land in a vug where it will do the maximum possible damage to the specimen. (Also known as the Law of Selective Gravitation.)

Child with Autism Adds to His Rock Collection

by Jim Kostka

Vaughan Walkosek (pictured below), a second-grader at Hoffman–Boston Elementary School in Arlington, VA, recently visited my garage with his family. They sorted through my estate salvage samples and scraps from my old lapidary cuttings, using plastic bead boxes to make four mineral boxes. They also made a fifth box of "pretty rocks"—lapidary and jewelry items. The family now has five plastic bead boxes to add to Vaughan's collection under his bed, much of it from my garage.

Upon leaving, Vaughan's mom asked how they could repay me, and I told her just to watch for sales at craft stores such as Michael's and give me any empty plastic bead boxes she could. The more plastic boxes I have, the more I can help kids, schools, and nature centers build their collections.

I owe a huge thank you to NVMC member Bill Oakley for donating over 40 empty plastic boxes to my garage a few months ago. Most of them are already gone! So if anyone has any, I'd be more than happy to take them!

While visiting the one quarry of the year that requires hardhats, a quick glance in the car trunk will prove that yours is home in the garage.

That same garage will prove to be more than 200 miles from the quarry.

Allen's First Law: The only tool you left at home will be the one you needed most.

Allen's Second Law: Most of the tools you did bring will not be needed.

Laws of Field Collecting

The need to go to the bathroom increases with the distance away from the facilities.

Black flies do not live in the woods until you start to dig, when they instantaneously appear to hold their annual convention.

Jack's Law No. 1: The mine owner will always point out a hole in which someone "pulled out a fantastic bunch of azurite last week!"

Jack's Law No. 2: No azurite will be found in said hole.

Jack's Law No. 3: It will take you all day to discover the truth of Jack's Law No. 2.

When trimming matrix—in apparent defiance of Mohs—beryl will always break before feldspar.

The best crystal of the trip will be found lying on the ground by a 10-year-old who will exclaim "Is this rock any good?"

Collecting in Utah near Capital Reef National Park

by Pat Flavin

In Utah, you can easily collect on public land managed by the federal Bureau of Land Management. You just park your car and walk through the desert.

The terrain is sandy, spotted by low brush, and agates are everywhere—I found a small collection in 20 minutes! You just grab the treasures while keeping a sharp eye out for rattlers.

Fortunately, we didn't see any snakes—but what a treasure trove of agates!

A Piece of NVMC History

At the May club meeting, Jim Kostka displayed a plaque from June 1964 certifying that the NVMC was a member of the EFMLS. Jim found the plaque in the estate of Alvin C. Benkelman of Warrenton, VA.

Al or "Benk," as he was known, joined the club in the 1960s, when he and his wife Carol lived in Fort Hunt, VA. In 1973, he moved to Warrenton, where he continued pursuing our hobby.

The plaque now resides in the club storage shed. Our club might have formed as early as 1953, although EFMLS has no record of NVMS membership until 1964. Was that our founding year?

Fall Fun at Wildacres

by Steve Weinberger, Wildacres Committee Chair (adapted from EFMLS News, *April 2014)*

WILDACRES IN THE FALL ... cool breezes after a long, hot summer. Days spent enjoying our hobby without interruptions. Being served delicious meals without having to cook them. Learning new skills from wonderful instructors. Gaining new knowledge from our interesting speaker. And all at a very reasonable cost of $390 per person for the week (class supplies are extra). What more could anyone ask for?

For over 40 years now, the EFMLS has enjoyed the Wildacres facility, using it to conduct its educational retreats. People have come back year after year to participate in this excellent opportunity to immerse themselves in our all-encompassing program. Registrants gain new knowledge and skills, and many develop lifelong friendships with other participants.

Our speakers over the years have run the gamut, from mineralogists, to geologists, to jewelry experts, to world travelers. This fall, we are pleased to have Justin Zzyzx, a well-known mineral collector and editor, as our Speaker-in-Residence. Justin, who will be accompanied by his wife Brandy, will present six talks during the week and participate in all our activities.

If you've not yet registered, why not do so now? The earlier you do, the better your chance of getting your preferred classes. The dates are September 1–7. You can take classes in Cabochons (Intermediate), Geology II, Glass Engraving and Etching, Faceting, Lost Wax Casting, Silversmithing II, Soapstone Carving, and Wire-Wrapped Jewelry (Intermediate). For more information, go to the Wildacres Website: http://efmls-wildacres.org/page5/index.html.

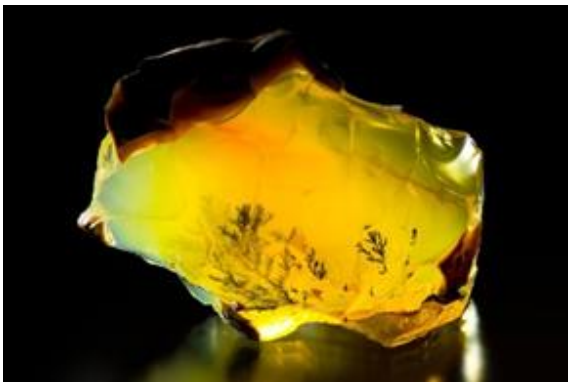
Wildacres Needs Your Help!

Steve Weinberger recently put out a call for help. Low registration could result in cancellation of the Wildacres fall session. Take advantage of this opportunity to indulge in your hobby and sign up today!

Good food and company in a spectacular setting.

We still have openings available, but do what a very wise person once told me: "Handle a piece of paper once, then it's not forgotten." Simple advice, but how many of us put things off until too late?

Hoping to see you on the mountain in September. You'll be delighted you decided to come!



Opal with dendrites, from a Wildacres photography class. Photo: Gerry Cox.

Bulletin Editors' Competition

by Hutch Brown, Editor

After experiencing the Bulletin Editors' Annual Competition for the first time last year, I figured I'd share some thoughts about how it works. Part of my job as newsletter editor is to make the submissions. It's complicated, but anyone can win an award!

AFMS Categories

The American Federation of Mineralogical Societies has fewer categories for the competition than the Eastern Federation of Mineralogical and Lapidary Societies. The EFMLS competition comes first, with winners announced in the spring. The EFMLS then forwards the top three winners in each AFMS category on to the national organization, which announces its own winners in the fall.

Newsletters are judged in four categories: mini (5 pages or less), small (6 to 11 pages), large (12 pages or more), and "new editor." The judges look for basics (such as spelling and presentation), club and federation news, and overall article quality. Next winter, I will submit a couple of representative issues in the "large" category.

Articles are judged based on such criteria as style and language, author effort, and article value and quality. If you submit an article that reflects your own knowledge and/or research (something more than a report that anyone could write), I will almost certainly submit it in the competition. So don't be shy!

The AFMS category for articles is technical or educational. Articles must be original submissions at least half a page long that provide technical information (such as mineral descriptions) or teach readers how to do something (such as lapidary work). To give you an idea, I have reprinted a second-place winner from 2013 below.

There is a separate category for "advanced authors"—authors who are professionals in fields related to our hobby or who have won first place in the AFMS competition in the past. Some authors qualify, but not many.

And the Trophy Goes to …

… the first-place winners in the 2014 EFMLS contest. For an idea of what judges are looking for, you can look up most winners online.

New Editor
Kristin Lolmaugh, *The Rockhounder*
Gem, Lapidary and Mineral Society of Montgomery County, Maryland

Small Bulletins
Mike Seeds, *The Conglomerate*
Baltimore Mineral Society

Large Bulletins
Carolyn Weinberger, *Gem Cutters News*
Gem Cutters Guild of Baltimore

Educational Articles
Michael Pabst, "Bequerelite and Kasolite"
The Mineral Mite, Nov. 2013
Micromineralogists of the National Capital Area

Original Educational Articles–Advanced
Mike Seeds, "Shoebox Adventures: The Hematite Rabbit," *The Conglomerate*, Sept. 2013, Baltimore Mineral Society

Original Nontechnical Articles
John Betts, "Quick Test Method for Determining Specific Gravity," *Bulletin of the New York Mineralogical Club*
New York Mineralogical Club

Written Features
Don Greaves, "John Wolf Memorial Field Trip," *The Rostrum*, Jan. 2013
Maryland Geological Society, Baltimore

Junior Drawn Features
Isabella Brandon, "Scratch Board"
Rock Buster News, Central Pennsylvania Rock and Mineral Club, Harrisburg, PA

Poetry
Betsy Oberheim, "Remember"
Rock Buster News, Central Pennsylvania Rock and Mineral Club, Harrisburg, PA

Junior Poetry
Helen Padgett, "Sparkly Crystals"
Mineral Minutes, Oct. 2013
Mineralogical Society of the District of Columbia

Junior articles are in two categories: under 12 and from 12 to 17. They are judged based on author age; for example, more research and polish is expected from a 15-year-old than from a 12-year-old. We need juniors to submit pieces, because I don't think many do—and I suspect that the chances of winning are great!

Both federations accept poems. NVMC member Sheryl Sims won second place in the 2013 AFMS competition for "I Ain't Nuthin but a Rockhound" (in *Mineral Minutes*, March 2012). Poems are judged based on such criteria as quality and appeal. Are you a poet? Why not try?

EFMLS Categories

The EFMLS has additional categories that the national federation lacks. For articles, the distinctions are subtle, and I erred on the side of caution last year. This year, I will be bolder, submitting articles in the AFMS technical and educational category if at all possible. That way, winning articles can be passed on to AFMS and have a chance to win there as well.

One EFMLS category is for original nontechnical articles. Such articles are informational rather than technical; for example, they might be a book review or a show critique. Again, they go beyond a simple report that anyone could write, reflecting your own knowledge and experience.

Another EFMLS category is for written features that "add spice" to the newsletter. They might be an imaginative "Prez Sez," a humorous anecdote, or an important bit of club news. An example from last year is Kathy Hrechka's "Happy 94th Birthday! Fred Schaefermeyer, 1/28/19."

The EFMLS has one final category: drawn features, such as cartoons or drawings related to our hobby. I have yet to receive any submissions in this category, but they would be fantastic! Any amateur artists out there? We will run anything!

The bottom line is this: anyone who makes a submission to our newsletter has a good chance of winning an award of some kind. So why not give it a shot? I'm a professional writer/editor and a science writer for the U.S. Forest Service, so you have an unfair advantage: I will do everything possible to spruce up your piece!

Giants Take Baby Steps

by Erich Grundel

Editor's note: The article is adapted from Mineral Minutes *(newsletter of the Mineralogical Society of the District of Columbia), May 2012, p. 6. It won second place in the 2013 AFMS Bulletin Editors' Contest for technical/educational articles.*

Regardless of your source of information about minerals, you have surely seen descriptions like "world's greatest," "best in the world," and "finest known example." Such designations are, of course, the opinions of writers, collectors, editors, experts, curators, and so forth—the usual assortment of egotists. Given that disclaimer, let me join the crowd.

The greatest discovery of mineral specimens *ever* took place a little more than a decade ago. You have not seen any of the specimens for sale; no collector has obtained them, and no museum has access to them. Yet the crystals have been seen by millions through such media outlets as the Discovery Channel, the Mineralogical Record, and YouTube.

Two brothers working in a silver mine in Mexico—in Naica, Chihuahua—broke into a cavern containing more than 150 individual crystals and rosettes of gypsum. The Cave of Crystals, as it is now known, has the largest free-standing gypsum crystals ever found. The largest individual is more than 37 feet long and more than 3 feet across and weighs approximately 40 tons. The splendor of this spectacle of nature is extraordinary. It is also a puzzle: how do such giants come into existence?

Naica Cave of Crystals (note person for scale). Source: Wikipedia.

Gypsum crystal from the Naica Mine. Source: Wikipedia.

Gypsum is a common mineral, one with economic value when found in large deposits. The origin of most gypsum is well understood: evaporation of mineral-rich water at the surface of the Earth. The precipitated mineral is then buried under sediments, waiting for humans to uncover. But surface evaporation cannot explain the origin of the Giants.

In recent years, the field of mineral growth has seen the development of tongue-twisting techniques with names such as high-resolution atomic force microscopy, laser confocal differential interference microscopy, and phase-shift interferometry. These techniques allow nanoscale observation of growth processes. For example, they have uncovered an explanation for something that has perplexed mineralogists and collectors for centuries: the bewildering morphological complexity of calcite. Using a technique called high-resolution white-beam phase-shift interferometry, scientists have now come up with an explanation for the origin of the giant gypsum crystals of Naica (Van Driessche et al. 2011).

The explanation hinges on one of the most fundamental and pervasive concepts in science: equilibrium. We use the word in everyday language to indicate a balance between things. The same holds true here—in this case, a chemical balance.

Chemically, gypsum is calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$). The mineral anhydrite is just calcium sulfate ($CaSO_4$). Under the right conditions, anhydrite can dissolve in water and precipitation (crystallization) can occur, yielding gypsum. The parameters that determine these reactions include temperature and the concentration of dissolved minerals in water. Dissolution and precipitation under specific conditions form the equilibrium of the system.

At Naica, the conditions of the equilibrium are a water temperature of 50–58 ºC and a supersaturation index (SI) of ≤ 0.05. The SI is a measure of how much material (in this case anhydrite) is dissolved in the water. According to Van Driessche et al. (2011), this is a very narrow range of temperature and SI for an open cave system. Raising the temperature will, up to a point, favor more anhydrite dissolution, but no precipitation of gypsum will take place; lowering the temperature will reduce or eliminate dissolution. Making the solution more saturated will hasten precipitation (at 55 ºC), forming many small crystals; less saturation will produce no crystals at all (at 55 ºC).

One of the loose gypsum crystals in the cave was exposed to the current Naica waters and the rate of growth was observed using the above-mentioned technique. At 55 ºC, the slowest growth rate ever recorded for a naturally growing crystal was observed: $1.4 \pm 0.2 \times 10^{-5}$ nanometers per second (translation: 10^{-5} nm/s = one hundred-thousandth of one billionth of a meter per second). So it took hundreds of thousands of years for the crystals to reach their current enormous size! It is truly a case of giants taking baby steps. This is an unbelievably long period of time for an open cave system to maintain its equilibrium under natural conditions. As we know, the Earth is very dynamic, and such long-term stability is extremely uncommon.

Water drained from the cave in 1975; until then, the crystals were still growing. Today, the cave is sealed to prevent damage to this natural treasure. Conditions in the cave are such that a breathing apparatus is required.

Source

Van Driessche, A.E.S.; Garcia-Ruiz, J.M.; Tsukamoto, J. [et al.]. 2011. Ultraslow growth rates of giant gypsum crystals. Proceedings of the National Academy of Sciences 108(38): 15721–15726.

Story of Virginia's Bull Run Mountain

by Hutch Brown

Author's note: The piece is mainly based on Bentley (2012a) and Fichter and Baedke (1999), both referenced at the end.

As you drive west on I–66 from Washington, DC, you might be forgiven for thinking you are approaching the Blue Ridge Mountains as you pass the town of Haymarket, VA. A ridge looms before you, with rocky outcroppings reminiscent of the Blue Ridge, yet you are less than an hour's drive from Washington.

Then you pass through the ridge at Thoroughfare Gap, with cliffs to the left and right—and suddenly you are in a landscape of rolling foothills. You see the Blue Ridge ahead, and you realize that you still have a bit to go.

What gives? Are you in the Blue Ridge or not? If not, why is that ridge there? If so, why don't the ridges continue beyond?

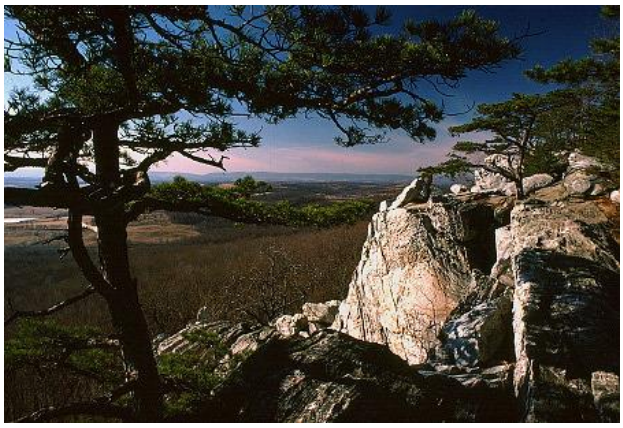
Rock Sequence

You have just passed through Bull Run Mountain, a ridge that parallels the Blue Ridge but lies well to the east (fig. 1). It is an extension of Catoctin Mountain to the north in Maryland, just as the Blue Ridge is an extension of South Mountain and other ridges to the north. Although the names change, the landforms remain roughly the same, trending northeast to southwest across the mid-Atlantic region.

And that is because the underlying geology is the same.

Bull Run Mountain is located on the border between the Blue Ridge and Piedmont geologic provinces of Virginia. It is primarily made up of three different rock types, all metamorphic: the western flank tends to be Catoctin greenstone, a metamorphosed basalt; in the middle is the Weverton formation, primarily quartzite, a metamorphosed sandstone; and toward the east is the Harpers formation, mainly phyllite, a metamorphosed shale.

How did this rock sequence form?



High Point Cliffs, Bull Run Mountain, facing west. Photo: Gary P. Fleming, 2003; source: BRMC (2013).

The story begins about 570 million years ago, when the supercontinent Rodinia was starting to break up. What is now Virginia was located in the middle of the supercontinent, which joined all of Earth's continents together. Rifting began on the eastern edge of proto-Virginia.

The bedrock was made up of granitic rocks called the Grenville basement complex. A hot

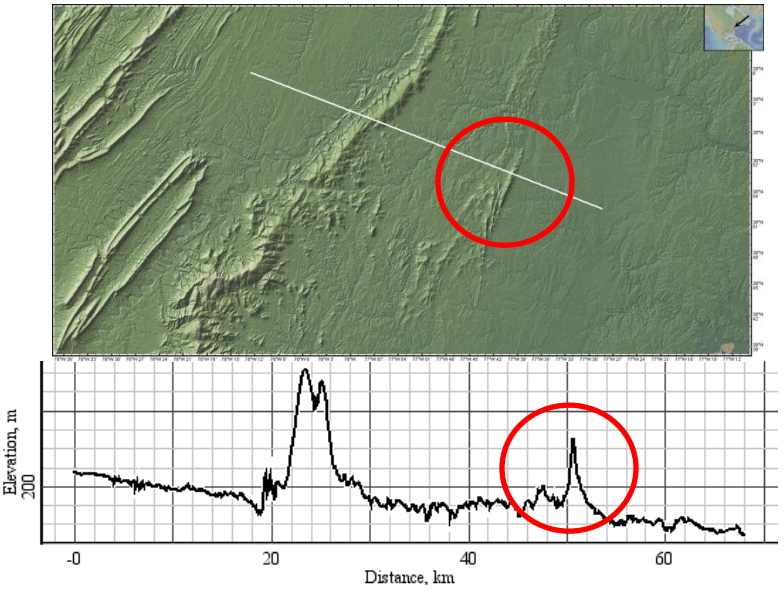


Figure 1—*Bull Run Mountain (circled) parallels the Blue Ridge to the west. The white line tracks the elevation changes in the Blue Ridge Province, which reaches roughly from the 52-kilometer line (east foot of Bull Run Mountain) to the 20-kilometer line (west foot of the Blue Ridge). An area of relatively heavy erosion lies in between. Source: Bentley (2012b).*

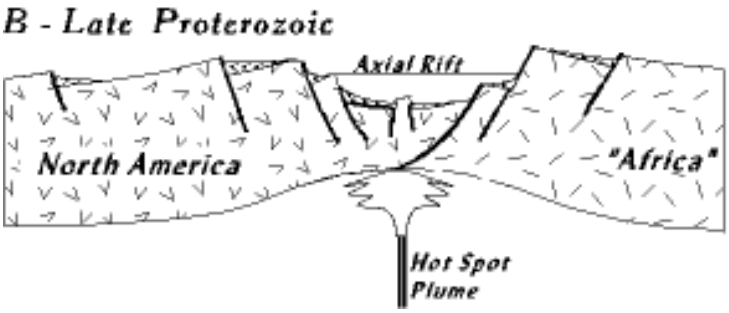


Figure 2—*Early Iapetan rifting about 570 million years ago (in the late Proterozoic era). A plume of magma at a weak spot under the Rodinia supercontinent is thinning the basement rocks, causing faults and slippage in the brittle surface rocks. The resulting rift valleys are filling with sediments from eroding cliffs. The main axial rift is forming a sea, like the Red Sea today, as the Iapetan Ocean begins to take shape. Source: Fichter and Baedke (1999).*

Rock types at Thoroughfare Gap: Catoctin greenstone (above); Weverton quartzite (above right); Harpers phyllite (right). Source: Bentley (2011, 2012a).

spot under the supercontinent thinned the Grenville rocks and pulled them apart, creating a series of rifts (fig. 2). Huge fault valleys formed, like those in the Great Rift Valley of East Africa today, and they gradually filled with sediments. The rift valleys included the so-called axial rift that initiated formation of an ancient ocean called the Iapetan.

As the continents pulled apart, the edge of proto-North America sank beneath the sea, along with fault valleys (fig. 3). Sediments continued to accumulate offshore, filling the fault valleys and covering any exposed basement rocks.

Rifting caused magma to well up through the thinned basement rocks, spilling over the Grenville rocks and any overlying sediments. Much of the area was once covered by basalt, later metamorphosed into Catoctin greenstone.

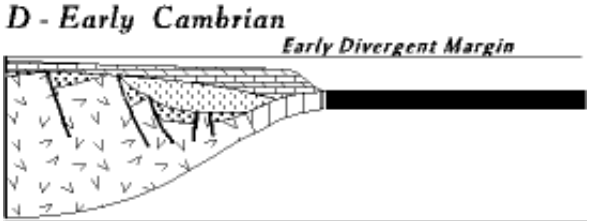


Figure 3—*The early continental margin about 530 million years ago (during the early Cambrian period), when proto-Africa and proto-North America were diverging, forming the Iapetan Ocean. Black bar = basalt (ocean crust); black lines = faults; V = igneous rock; bricks, dots, horizontal lines = sedimentary rock. Source: Fichter and Baedke (1999).*

Sediments continued to accumulate, covering the basalt. In time, shales and sandstones resulted, forming the basis for the Chilhowee group of metamorphic rocks. For example, Weverton quartzite was once a sandy beach covering the basalt that became Catoctin greenstone, and the Harpers mud and sand sediments were likely laid down over the beach when the sea rose.

By about half a billion years ago, the pieces were all in place. Sedimentary rocks known as the Lynchburg Group overlaid the Grenville basement rocks; in turn, they were covered by basalt, and the sedimentary layers of the Chilhowee Group covered the basalt.

But none of the rocks were yet metamorphic. Metamorphism takes tremendous heat and pressure. What metamorphosed the rocks? And how did they get from the continental margin deep into the interior of Virginia?

Mountain-Building Island Arcs

When the Iapetan Ocean began to close again, a series of continental collisions resulted, each causing mountains to build. From about 450 to about 350 million years ago, two island arcs collided with proto-North America in a consecutive pair of mountain-building events (called orogenies), with a long period of tectonic calm in between. An island arc is a chain of volcanic islands, usually shaped like an arc, that forms

where one tectonic plate in the ocean subducts under another.

As the ocean crust subducted under each approaching island arc, it acted as a ramp (fig. 4). Each arc—first the Taconic, then the Avalon—rode up over the continental margin, attaching itself to proto-North America.

The added land masses are known as terranes, fragments of crustal material broken off from one tectonic plate and sutured onto another. The immense weight of each terrane forced down the continental margin, forming basins ahead of the rising mountains (fig. 4).

The Taconic and Acadian orogenies might have caused metamorphism in the underlying rocks, forming Catoctin greenstone, Weverton quartzite, and Harpers phyllite. If not, then the next orogeny certainly did, because it was bigger.

Alleghanian Orogeny

About 320 million years ago, the Iapetan Ocean completely closed as the African continental plate collided with what is now the eastern part of the North American plate, contributing to the formation of the supercontinent Pangaea.

As with the earlier terranes, the dipping subduction zone acted as a ramp, allowing proto-Africa to slide up over the edge of proto-North America (fig. 5). The enormous weight of the African continental plate and the tremendous heat and stress generated by its collision with proto-North America not only metamorphosed the underlying rocks, but also displaced them, moving them long distances and forming several of the geologic provinces of Virginia we know today.

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. 5). Parts of the Taconic and Avalon terranes detached and moved inland, forming the belts of metamorphic rock that now make up the Piedmont Province.

The thinned and stretched Grenville basement rocks at the old continental margin also broke free. Together with immediately overlying rocks, including the Lynchburg group, Catoctin greenstone, and Chilhowee group, they moved inland along a great thrust fault. They ultimately came to rest over much younger rocks, forming an overturned anticline (fig. 6).

Small-Scale Structures

Bentley (2013a, 2013b) has shown in detail how the small-scale structural features of the area near Thoroughfare Gap can help you piece together the broader geological structure of the entire Blue Ridge Province. In plate tectonics, small-scale structures mirror the larger geological processes taking place.

For example, during a field trip with students in April 2012, Bentley (2012a) found "a kink fold of the Harpers formation." The kink shows "a regional shearing up and to the left"—that is, to the west. The shearing "provides evidence that this is in fact the eastern limb of an anticline with its center to the west" (fig. 7).

Figure 4—*The Acadian orogeny, about 380 million years ago (during the middle to late Devonian period), followed the Taconic orogeny, when an earlier island arc collided with North America. The old Taconic mountains are eroded away, and sediments from the new Avalon terrane are filling the Catskill foreland basin, forming sedimentary rock. Black bar = basalt (ocean crust and extinct subduction zones); black lines = faults; dots = sedimentary rock. Source: Fichter and Baedke (1999).*

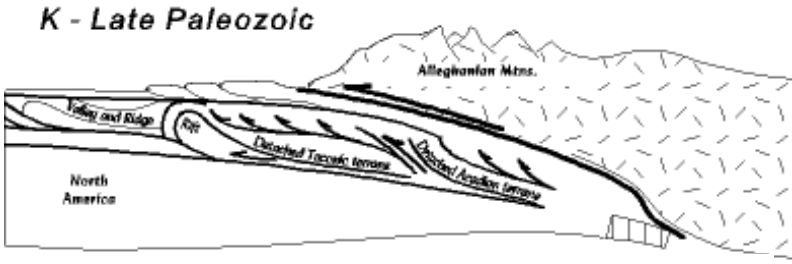


Figure 5—*The Alleghanian orogeny, about 320 million years ago (during the late Paleozoic era). As proto-Africa rides up over proto-North America, massive thrust faulting pushes both the Taconic and Avalon terranes and some of the Grenville basement rocks westward while folding the flat sedimentary rocks beyond. Source: Fichter and Baedke (1999).*

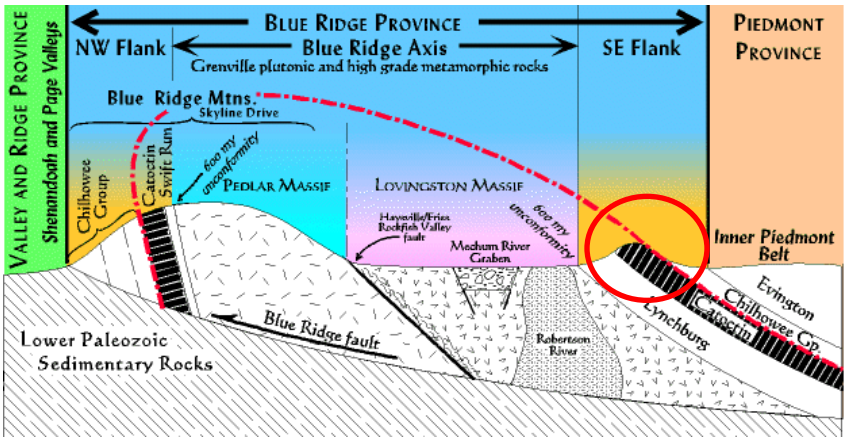


Figure 6—*The Blue Ridge thrust fault and overturned anticline. Bull Run Mountain (circled in red) is at the eastern edge of the anticline. Note the location of the Lynchburg group, Catoctin greenstone, and Chilhowee group over the Grenville bedrock. Source: Fichter and Baedke (1999).*

Additionally, the dip of the beds in the Weverton and Harpers formations is to the east, whereas the corresponding formations on the west side of the Blue Ridge dip to the west. So the evidence is incontrovertible: the Blue Ridge Province forms a massive anticline. Moreover, the stratigraphic relationships on the west side of the Blue Ridge show that the anticline was overturned (fig. 6), with the Grenville rocks overlying younger formations, indicating a thrust fault to the west.

Blue Ridge Erosion

So the rocks that make up Bull Run Mountain are clearly part of the Blue Ridge geologic province. With origins in the Iapetan rifting event about 570 million years ago, the Bull Run rocks are closely associated with the underlying Grenville rocks. During subsequent mountain-building events, the Bull Run rocks were metamorphosed and displaced along a thrust fault far to the west of their original location on the continental margin. They now form the eastern limb of an overturned anticline, with the Grenville rocks at its core (fig. 6).

But much of the core granitic rock between the eastern and western limbs of the Blue Ridge anticline has eroded away, leaving a rolling landscape of low ridges and hills. Granitic rock, rich in feldspar and quartz, is normally erosion-resistant; so what happened? Why are there no high ridges between the two anticline limbs?

Part of the answer might be that the Blue Ridge anticline was always irregular in shape. The Grenville rocks at the continental margin were already heavily faulted by the Iapetan rifting event; for example, they included the original

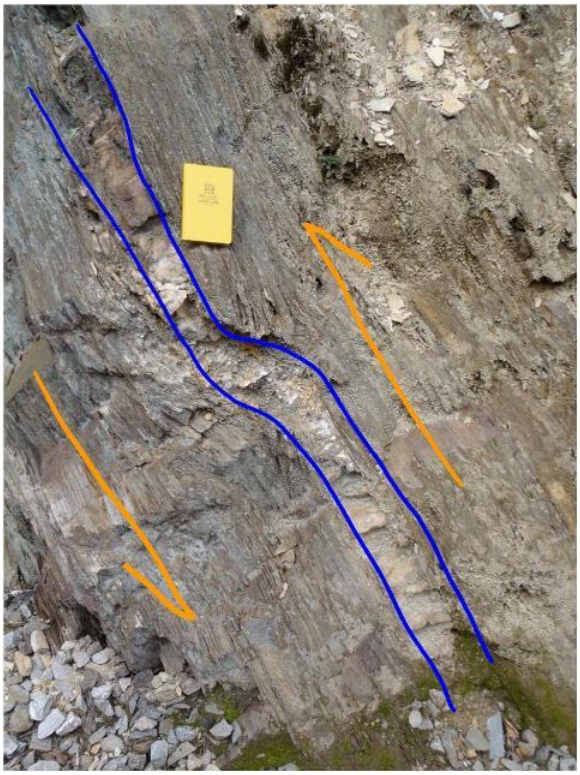


Figure 7—*Harpers phyllite at Thoroughfare Gap, Bull Run Mountain. On a small scale, the rock movement shown reflects the shearing forces of the thrust fault that produced the Blue Ridge overturned anticline. Source: Chris Johnson, in Bentley (2012a).*

Looking east from Old Rag Mountain (fall color is mostly hickories and tuliptrees), you see low ridges and hills in the Blue Ridge Province. The "foothill" topography is more rugged than in the Piedmont Province beyond. Photo: Hutch Brown.

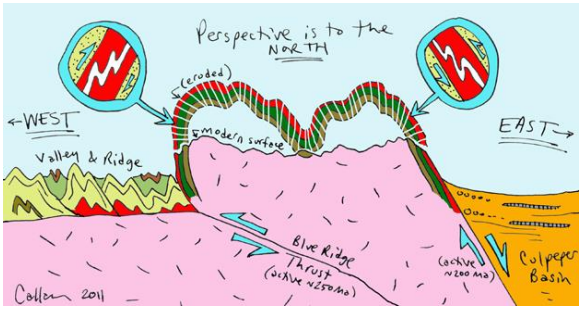


Figure 8—*Blue Ridge anticline, with its likely jagged original topography due to Iapetan rifting on the continental margin. Source: Bentley (2013a).*

axial rift, considered by some to be the Mechum River formation (fig. 6). After thrust-faulting during the Alleghanian orogeny, the Blue Ridge anticline likely had a jagged topography before any erosion took place (fig. 8).

Moreover, the folding, faulting, and metamorphism associated with the Alleghanian orogeny might have weakened the granitic Grenville rocks while making the overlying basalt harder and more erosion-resistant. According to one source, the mountain-building processes crushed the grains of the granitic rocks, leaving cracks that groundwater could seep into.

By contrast, the same processes recrystallized the basaltic rocks, turning them into the "mechanically impervious rocks we call greenstones" (Frye 1986). And Weverton quartzite has the hardness of its quartz component, making it potentially more erosion-resistant than granitic rocks, which have less quartz and more feldspar, a softer material.

Atlantic Rifting

Something of an optical illusion might also be at play. The eastern side of Bull Run Mountain is considerably higher than the western side (figs. 1, 8), because the Piedmont rocks to the east are more easily eroded than the metamorphic and granitic rocks in the Blue Ridge Province to the west (fig. 6).

Why would that be? Isn't the Piedmont also made up of tough metamorphic rocks?

Yes and no. About 230 million years ago, the supercontinent of Pangaea began to break up. Upwelling magma found old fault lines between proto-Africa and proto-North America and reactivated them. A new axial rift formed the beginnings of the Atlantic Ocean, just as the old axial rift had formed the incipient Iapetan Ocean long before (fig. 2).

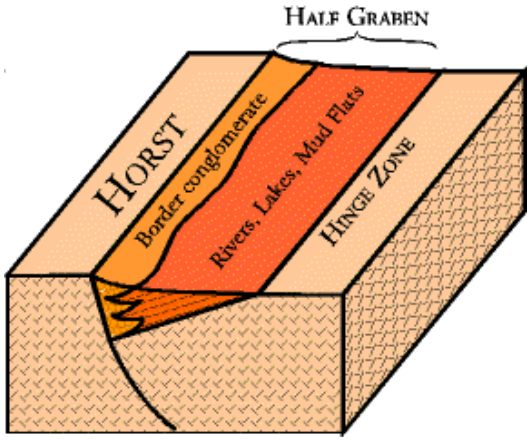


Figure 9—*Rift valley (half graben), formed during continental rifting. Uplift cracks the rock along a fault line (curved black line above). The bedrock drops down the fault line from a hinge zone to the right, forming a giant escarpment called a horst. Outwash gathers at the foot of the horst, forming coarse conglomerate rock. Rivers and lakes in the basin deposit finer sediments that form siltstones, shales, and sandstones as the rift valley fills . Source: Fichter and Baedke (1999).*

The axial rift formed a graben, a term derived from the German word for trench. As the hot spot of upwelling magma broke the brittle overlying rock, an enormous slab of rock dropped down along faults on both sides (fig. 2). Parallel to the axial rift were half grabens, with a fault on only one side, caused by uplift and doming at the hot spot (figs. 2, 9).

The continental uplift reactivated the ancient fault line between the Blue Ridge basement rocks and the Piedmont terranes. Along the eastern edge of Bull Run Mountain, the metamorphic Piedmont rocks slid down along their ancient fault line with the Grenville basement rocks, as if on a hinge (fig. 9).

Bull Run Mountain became a horst, from the German word for eyrie—a huge escarpment looming over the half graben. The rift valley to the east, now known as Culpeper Basin, extends from what is now Frederick, MD, to about 40 miles south of Manassas, VA (fig. 10). Today, the axial rift is buried far to the east, under the continental shelf, as are other half grabens.

Even while Culpeper Basin was still forming (which took tens of thousands of years), it was already starting to fill (fig. 9). Rifting was associated with volcanic activity and lava flows that became layers of basalt. Gravels and sands washed from the horst in great alluvial fans, and rivers drained the basin, along with associated lakes.

Over a period of about 30 million years, the basin gradually filled with river and lake deposits and other sediments. The accumulated sediments consolidated into various kinds of sedimentary rock: siltstones, shales, sandstones, and conglomerates, including Balls Bluff siltstone, Bull Run shale, and Manassas sandstone.

The sedimentary rocks of Culpeper Basin are softer than the metamorphic and igneous rocks to the west. As the sedimentary rocks wear away and gentle uplift continues, Bull Run Mountain is starting again to loom over the landscapes to the east, resembling the great rift valley escarpment that it once was.

An Exceptional Place

So as you enter Thoroughfare Gap, you have indeed entered the Blue Ridge Province. The rocks around you are intimately related to the rocks in the mountains ahead. They form Bull Run Mountain because the metamorphosed rocks you see are so erosion-resistant—and because you are in a highly unusual place.

The theory of plate tectonics is not that old. I remember lying on my bed as a teenager and staring at a map of the world on my wall, noticing that Africa and South America fit together like pieces of a puzzle. I remember asking about it and being told in no uncertain terms that it was sheer coincidence.

In 1966, however, John Tuzo Wilson, a Canadian geologist, took up an idea first proposed by the German geologist Alfred Wegener in 1912 but roundly dismissed at the time. Wegener (pronounced VEH-ge-na) theorized that the Atlantic Ocean had repeatedly closed and reopened. Wilson agreed and found more proof, and in honor of his ground-breaking work in plate tectonics, each cycle of the ocean closing and reopening is now called a Wilson cycle.

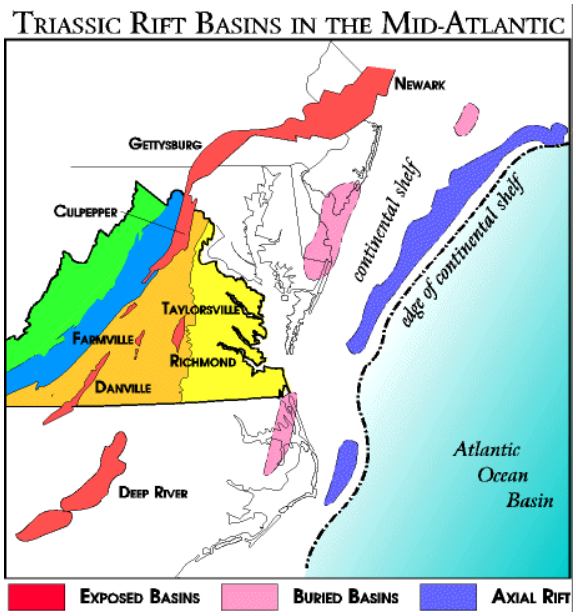


Figure 10—*Location of Culpeper Basin (circled), in the Piedmont at the edge of the Blue Ridge Province (blue). Other rift basins formed at the same time, during the Triassic period. Some are exposed (red), whereas others are buried under sediments on the Coastal Plain (pink). The axial rift (blue) is buried far out to sea, along the edge of the continental shelf. Source: Fichter and Baedke (1999).*

The area around Bull Run Mountain is ground zero for two full Wilson cycles. Over more than a billion years, the nearby rocks have been shaped by two cycles of mountain-forming and ocean-rifting events, when two different supercontinents formed, then pulled apart again—first Rodinia, then Pangaea. If that's not a remarkable story, I don't know what is.

Remaining Puzzle

One puzzle remains. The Bull Run Mountain rocks are clearly more erosion-resistant than the granitic rocks immediately to the west, where erosion keeps better pace with the gentle regional uplift that has formed Bull Run Mountain and its water gap—and the Blue Ridge Mountains and water gaps to the west.

But that is not true of the granitic rocks in Old Rag and the other ridges on the west side of the Blue Ridge anticline, which are considerably higher than Bull Run Mountain (fig. 1). Which begs one final question: why are the granitic rocks in the eastern part of the Blue Ridge Province so much higher than in the west?

Acknowledgment

Thanks to Callan Bentley, Assistant Professor of Geology at Northern Virginia Community College, for reviewing and commenting on the article. The author is solely responsible for any errors.

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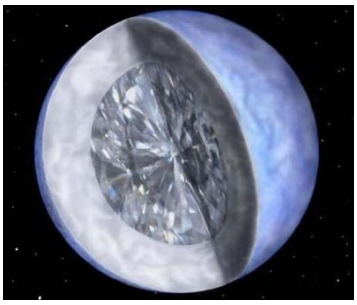
When you really want to get to that vug beneath the boulder …

Thanks to Jim Kostka for providing the image, part of a set of patently unsafe activities called "Why there are more women than men in the world."

Biggest Diamond Ever Found!



by Stephen Cauchi

Editor's note: The piece is adapted from Goldrush Ledger *(newsletter of the Charlotte Gem and Mineral Club, Charlotte, NC), March 2008, p. 8. The original source is* The Age, *an online Australian newspaper at http://www.theage.com.au.*

Astronomers have actually found a diamond in the sky, visible at night above Australia. It is the biggest known diamond in the universe.

According to American astronomers at the Harvard–Smithsonian Center for Astrophysics, a white dwarf star in the constellation Centaurus, next to the Southern Cross, has a core of crystallized carbon—in other words, diamond!

The core is about 1,860 miles in diameter and weighs 10 billion trillion trillion carats, or a 1 followed by 34 zeroes. By comparison, the biggest earthly diamond is a British crown jewel, the 530-carat Star of Africa.

Known officially as BPM 37093, the star confirms a theory, first proposed in the early 1960s, that cool white dwarfs have diamond cores. When a star the size of our sun burns out and dies, it often leaves behind a white dwarf. The intense pressure at the heart of such dead stars compresses residual carbon into diamond.

Some people refer to the star as Lucy, a tribute to the Beatles song "Lucy in the Sky with Diamonds." Lucy "pulsates," sending out light at regular intervals. By measuring the pulsations, astrologists were able to study the interior of the white dwarf, just like seismograph measurements of earthquakes allow geologists to study the interior of the Earth.

Our own sun will become a white dwarf when it dies in about 5 billion years. Two billion years later, its ember core will crystallize, leaving another giant diamond in our solar system.

Maybe DeBeers was right: "Diamonds *are* forever!"

Ferruginous Quartz
A Mineral Detective Story

by Lee Tori

Editor's note: The piece is adapted from Rock Chatter *(newsletter of the Rock and Mineral Club of Lower Bucks County, PA), January 2014, pp. 5–6.*

From time to time, my wife and I buy small mineral collections to provide new material for the sales table at club meetings. In 2000, I purchased a fairly large collection with a number of "old-time" pieces. Among them were several small, opaque, deep red crystals of quartz that I recognized as ferruginous (iron bearing).

The label read "Hyacinth de Campostella, Spain." Checking my mineral dictionary, I learned that the term hyacinth dates to the Middle Ages. It refers to a reddish, pink, or violet gemstone of any variety.

The medieval meaning of hyacinth has been lost. Today, "hyacinth" refers solely to the spring flower that blooms around Easter.

The mineral dictionary went on to define "hyacinth of Campostella" as "red ferruginous quartz crystals from gypsum beds near Santiago de Campostella in Northern Spain."

Santiago de Compostela (note the actual spelling) is a city of nearly 100,000 in northwestern Spain. It is famous for its cathedral, completed in 1211; according to legend, the cathedral houses the bones of St. James the Apostle. Since the late Middle Ages, devout Catholics have journeyed to the cathedral to venerate the holy relics, coming from all over Europe. Santiago de Compostela became the most important Christian place of pilgrimage, after Jerusalem and Rome.

The medieval pilgrims had a quaint custom. After venerating the relics of St. James at the cathedral, they traveled on to the nearby gypsum beds, where they searched for small red quartz crystals. These crystals were treasured as mementos of a successful pilgrimage. We can presume that the crystals were also for sale at shops in town.

The crystals are still found today, though in lesser quantities. I have several small ones in my collection. I also purchased a much larger superb crystal from another location in Spain and mounted it in a thumbnail box.

Ferruginous quartz.
Toba, Valencia, Spain.
Lee Tori specimen 6135
(1 inch tall by ½ inch wide).

The point of my story is that the study of minerals can be a window to a wider world. No doubt many of you can recount similar experiences of how searching for minerals—or researching the ones you have—can lead to unexpected discoveries.

Upcoming Events
(of interest in the mid-Atlantic region)

June

7: 62nd Semi-Annual Mineralfest; Pennsylvania Earth Sciences Association; Macungie Memorial Park, Poplar Street, Macungie, PA

13: Club auction, Chesapeake Gem and Mineral Society; 7:30 p.m. (preview at 7:15 p.m.); Westchester Community Center, 2414 Westchester Ave., Oella, MD 21043

July

11–13: 2014 AFMS/RMFMS Convention and Show; Central Park Hall, Tulsa Expo Square, 21st and Yale, Tulsa, OK; Theme: Rocks and Gems of the Indian Territory; Fri/Sat 9–6, Sun 10–5; $6 for 1-day pass, $10 for 2/3-day pass, children 12 and under free; Finis Riggs, 918-587-4400, Lriggs1331@cox.net

August

2: Morris Museum Mineralogical Society, 20th Annual Gem, Mineral, and Fossil Sale; Delbarton School, Morristown, NJ; contact John Sanfacon, 201-787-0545.

8–10: East Coast Gem, Mineral, and Fossil Show (commercial show); Better Living Center, Eastern States Exposition, 1305 Memorial Avenue, West Springfield, MA http://www.mzexpos.com

15–17: Gem Miners Jubilee; Fri. 10–6, Sat. 10–6, Sun 10–4; admission: $6; Lebanon Expo Center, Lebanon, PA http://www.gem-show.com

September

1–7: EFMLS workshops at Wildacres Geology Retreat; fall classes, tuition $390 http://www.amfed.org/efmls

13–14: 49th Annual Gem, Mineral, Jewelry Show; Central PA Rock & Mineral Club; Zembo Shrine, 3rd and Division Streets, Harrisburg, PA; http://rockandmineral.org

27–28: 50th Annual Atlantic Coast Gem, Mineral, & Jewelry Show; Gem Cutters Guild of Baltimore; Howard County Fairgrounds, I-70 at MD 32; www.gemcuttersguild.com

November

1–2: 45th Gemarama; Tuscarora Lapidary Society; CFS, The School at Church Farm, 1001 E. Lincoln Hwy, Exton, PA 19431 http://www.lapidary.org

22–23: Northern Virginia Mineral Club Annual Show; George Mason University; Braddock Rd. and Rte. 123, Fairfax, VA. To volunteer, please click on http://vols.pt/fmg5iM!

Did You Know?

Editor's note: Adapted from Gem Cutters News *(newsletter of the Gem Cutters Guild of Baltimore County, MD), May 2014, p. 6.*

1. Did you know that the average person will eat about 15 pounds of salt in a year?
2. Did you know that cinnabar (mercuric sulfide) is one of the most poisonous minerals on earth?
3. Did you know that mercury is the only mineral that occurs as a liquid? It is also the only liquid metal. Mercury freezes at −38 °F.
4. Did you know that about 60 new minerals are discovered every year?
5. Did you know that a 1-inch garnet crystal took over 10 million years to grow to that size?

No more club meetings or newsletters until September. Have a great summer!

THE NORTHERN VIRGINIA MINERAL CLUB INC

Crystals are the flowers of the Mineral Kingdom

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http://www.novamineralclub

The Northern Virginia Mineral Club

You can send your newsletter articles to:

hutchbrown41@gmail.com

Visitors are always welcome at our club meetings!

RENEW YOUR MEMBERSHIP!

SEND YOUR DUES TO:
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OR

Bring your dues to the next meeting.

Purpose: To promote and 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, http://www.amfed.org/efmls) and the American Federation of Mineralogical Societies (AFMS—at http://www. amfed. org).

Dues: Due by January 1 of each year; $15 individual, $20 family, $6 junior (under 16, sponsored by an adult member).

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 22204. (No meeting in July or August.)

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