THE NORTHERN VIRGINIA MINERAL CLUB INC

The Mineral Newsletter

Next meeting: May 6 Time: 7:30 p.m.

Dunn Loring Fire Station, 2148 Gallows Road, Dunn Loring, VA

Sturmanite

N'Chwaning Mines, Northern Cape, South Africa

Source: Wikimedia Commons. Photo: Rob Lavinsky.

Volume 64, No. 5
May 2024
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May Meeting Program:

Fossils from Pennsylvania

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In this issue …

Deadline for Submissions

May 20

Please make your submission by the 20th of the month! Submissions received later might go into a later newsletter.

Mineral of the Month
Sturmanite

by Sue Marcus

We learn together about the uniqueness of each mineral we examine. This month, our mineral is sturmanite, which forms a variety of lovely crystals, both megascopic and microscopic.

Though well known from only one locality, sturmanite occurs in at least one other place. Why has it not been identified elsewhere? It's a mystery that I hope will be solved through future collectors finding new localities.

Name and Chemical Formula

Sturmanite was described relatively recently, in 1983, by three scientists, including Pete Dunn of the Smithsonian Institution. The original specimens were brought to these scientists by Dr. Richard Gaines, a mineralogist, an economic geologist, and a mineral collector. Gaines was also an editor of *Dana's New Mineralogy*. The trio who described the new mineral named it for Croatian-Canadian mineralogist Bozidar Danko Sturman, emeritus associate minerals curator of the Royal Ontario Museum.

It is difficult or impossible for most of us to tell the difference between sturmanite (with the chemical formula $Ca_6Fe^{3+}2(SO_4)_{2.5}[B(OH)_4](OH)_{12} \cdot 25H_2O$) and ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12} \cdot 26H_2O$). Are they a solid solution series?

Some sources state that they are. Others state that the chemistry of the two mineral species makes that impossible or unlikely. I'm not a geochemist, so I leave that determination to others.

Localities

South Africa. From 2.1 to 2.6 billion years ago, shallow seas deposited sediments in a region now called the Northern Cape Province of South Africa. The host rocks of the manganese ores in the Kalahari Manganese Fields are part of the Transvaal Supergroup.

The source of the layered (or cyclic) manganese (and iron) deposition is debated by geologists. The resulting layering of the metals may be caused by changes in the oxidation or reduction of the atmosphere and the marine environment, although those changes can be catalyzed by diverse geologic situations. Possibilities range from metals forming in ancient seas to submarine volcanism providing deeper sources of the metals to ancient glaciation.

Manganese enrichment occurred later, caused by processes that are also debated. Enrichment may have occurred during thrust faulting, when pressures of tectonism, with likely fluids driven upward, mobilized and concentrated the manganese. Another possibility is that erosion of manganese-rich sedimentary rocks provided the primary source of concentration.

Happy Memorial Day!

Northern Virginia Mineral Club members,

Our next club meeting will be on **Monday, May 6, 7:30 p.m.,** at our usual meeting place, the Dunn Loring Fire Station. Our speakers will be Chris and Cathy Haefner, who will give a remote presentation via Zoom; see program details on page 8. (***Note:*** We will not meet beforehand for dinner.)

Sturmanite on matrix, N'Chwaning II Mine, Northern Cape, South Africa. Source: Mindat; photo: Rob Lavinsky.

Sturmanite with ettringite and charlesite, N'Chwaning II Mine, Northern Cape, South Africa. Source: Mindat; photo: Rob Lavinsky.

Perhaps multiple forces were happening over geologic time. The host rocks are old enough to have undergone several phases of enrichment. The last significant leaching and enrichment event occurred about 1.1 billion years ago during the Namaqua Orogeny. Sturmanite crystallized in the late stages of that event.

The primary source of sturmanite, along with its type locality, is in the Kalahari Manganese Fields, which

Sturmanite, N'Chwaning Mines, Northern Cape, South Africa. Source: Mindat; photo: Michael C. Roarke.

extend for more than 90 kilometers (56 mi), from the Wessels Mine in the north to the Adams Mines in the south. Sturmanite occurs at several mines in the district in diverse morphologies, with enough variety that collectors can amass an impressive collection of this mineral alone from South Africa.

The type specimen was purchased at a Johannesburg mineral shop. I visited a Johannesburg mineral shop in the 1980s and bought a couple of lovely specimens of crystallized minerals from the Kalahari Manganese Fields. One was ettringite, a mineral previously unknown to me; the other was an unnamed mineral still being described—so I had bought a sturmanite specimen before the description was published! Did it come from the same Johannesburg shop? Might I then own a holotype specimen? I don't know because information on the commercial source of the type specimen remains unpublished.

Bruce Cairncross, a renowned South African geologist and mineral collector, told me that he similarly bought specimens of an unknown mineral from a Johannesburg shop—and they turned out to be sturmanite. He also noted that sturmanite cannot be definitively identified visually because it can easily be confused—or intergrown—with ettringite, charlesite, and jouravskite.

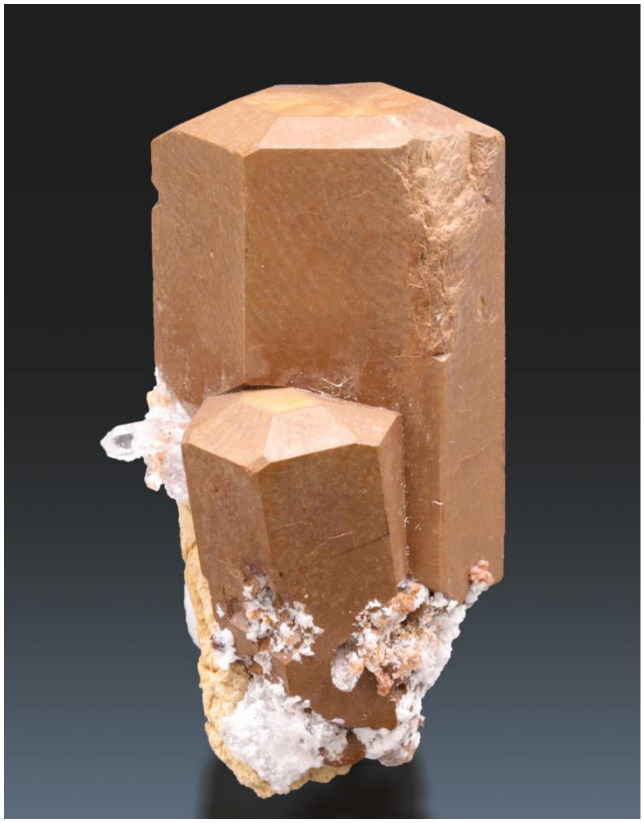
Sturmanite, N'Chwaning Mines, Northern Cape, South Africa. Source: Mindat; photo: Rob Lavinsky.

Peacor and others (1983), who wrote the original description, obtained additional samples from Dr. E.A.J. Burke, who had gotten them from a collector; these specimens were also from South Africa. One of these was sturmanite that had been mostly replaced by gypsum, according to Pecor and others (1983). That is curious because Mindat images show sturmanite pseudomorphing gypsum from the N'Chwaning II Mine. The Mindat photos show deeply striated opaque brown gypsum in the ram's horn habit of gypsum.

N'Chwaning is a group of three shafts (N'Chwaning I, II, and III) opened, respectively, in 1972, 1981, and 2004 for high-grade manganese ore; lower grade ore came from the Gloria Mine. The N'Chwaning shafts are usually known as separate mines even though they exploit the same deposit. N'Chwaning II has been the most productive of these mines for sturmanite, although the mineral occurs in lesser amounts at N'Chwaning I and even less at N'Chwaning III.

N'Chwaning I specimens can be prismatic, tabular, or like a segmented Asian hat, with flaring edges around a central axis. Crystals range from opaque through transparent; some are zoned. Colors can be greenish-yellow, honey-yellow, or tan. Sizes range from beautiful micros to bright 1-centimeter (0.3-in) crystals.

The world's most prolific sturmanite specimen producer is the N'Chwaning II Mine. Mindat shows the wide variety of sturmanite from this mine. Transparent, very pale yellow, barrel-shaped crystals are one



Sturmanite specimens, N'Chwaning Mines, Northern Cape, South Africa. Source: Mindat; photos: Enrico Bonacina (top), Rob Lavinsky (bottom).

form found here. Possibly the best known, though also possibly the most likely to be ettringite or some sturmanite-ettringite combination, are the bright greenish-yellow elongated crystals. These grew up to 5.4 centimeters (2.1 in) in size. Deep honey-yellow prismatic crystals are usually translucent and capped

Sturmanite, N'Chwaning II Mine, Northern Cape, South Africa. Source: Mindat; photo: Weinrich Minerals, Inc.

by shallow terminations. A10-centimeter (4-in) crystal is shown on Mindat, though the owner notes that it hasn't been analyzed and may be ettringite.

Pagoda-like stacked crystals are unusual and some are quite attractive. They formed as flattened hexagonal dipyramidal crystals. Opaque, etched copper-colored crystals form pseudoctohedrons and other geometric-shaped crystals. Some crystals are zoned from inside to outside. Others—the flatter type—show sectional zoning, a bit like an orange cut in half across the sections, with the sections having alternating colors. If you prefer micromounts, N'Chwaning II is the source of some gemmy, brilliant lemon-yellow crystals.

Specimens from N'Chwaning III, though scarce, have been found at least through 2014. Lustrous tabular crystals seem to be the norm. They are often transparent gemmy yellow or orange, similar in color to the range of colors in wulfenite. Sizes crystals range from micros to about 1 centimeter (0.4 in).

Bruce Cairncross showed a narrow 14-centimeter-long (5-in-long) sturmanite crystal from an unspecified mine in a videotaped presentation on the Kalahari Manganese Fields. In his book *The Kalahari Manganese Field* and in an email that he kindly sent me, Cairncross reports crystals of up to 40 centimeters (16 in) from N'Chwaning I and II.

One other noted South African sturmanite locality is the Wessels Mine. Sturmanite occurs at Wessels in many forms and colors. Mindat shows crystals that are translucent to opaque, orange-brown and hoppered, and look like tight flower buds that show lustrous external faces with duller, lower internal areas. White, yellow, orange, and coppery crystals can be transparent or translucent (or vary between them), forming micro- and macrocrystals.

The Kalahari deposit is huge—containing estimates reserves of 323.2 million tonnes (356.3 tons) of manganese ore containing 42.5 percent manganese. South Africa has the world's largest manganese reserves. The United States must import raw manganese because we are not a significant producer. However, sturmanite has no manganese in its formula (although manganese can substitute for iron) and is not an ore mineral.

Russia. The only other locality where sturmanite has been identified is Lakargi Mountain in the Baksan Valley of Russia's Kabardino-Balkaria region. Several references mention sturmanite occurring in Russia,

Sturmanite, N'Chwaning Mines, Northern Cape, South Africa. Source: Mindat; photo: Rob Lavinsky.

and Mindat lists sturmanite as one of many minerals from Lakargi Mountain, but I could not find any photos of Russian sturmanite or information about its abundance or possible crystal size. The geologic setting of Lakargi Mountain consists of pyroclastic flow rocks called ignimbrites that contain chunks (xenoliths) of skarn. This is a very different geologic setting that that of the South African sites.

Uses

Mineral collectors can enjoy sturmanite for its main use—as an interesting, unusual, and often attractive mineral. It has no other economic uses.

Faceted sturmanite is a novelty rather than a valuable gem for jewelry. With a hardness of 2.5, sturmanite is too soft to be a durable gemstone. Crystals that are large enough for cutting are rare and seldom transparent or translucent. A 1.27-carat gem was faceted from a sturmanite specimen coming from an unspecified South African locality. The stone, priced at $952, is pale yellow with purported inclusions of an unknown mineral, causing it to be transparent to translucent. A smaller (0.07-caret) faceted sturmanite from the N'Chwaning II Mine was offered for $185. This small gem is also transparent to translucent and is more deeply yellow than the larger cut stone but is poorly faceted, with cloudy orange areas that may be healed fractures.

Prices for sturmanite mineral specimens listed by online merchants ranged from $14.50 to $7,475. The top price gets you a specimen with a maximum dimension of 7.6 centimeters (3 in) and exhibiting a short stack of brownish-orange transparent to opaque crystals on matrix. A 4-centimeter (1.5-in) specimen priced at $14.50 shows a crust of greenish-yellow crystals, some euhedral and some broken, on matrix. It is identified as sturmanite/ettringite from South Africa's Kalahari Manganese Fields. A nice specimen will probably cost between $60 and $200. (All prices were found online April 11, 2024.)

Technical Details

Chemical formula ..... $Ca_6Fe^{3+}2(SO_4)_{2.5}[B(OH)_4](OH)_{12} \cdot 25H_2O$
Crystal form.............. Trigonal, hexagonal
Hardness................... 2.5
Specific gravity......... 1.85
Color .... Yellow, orange, brown, white

Sturmanite, N'Chwaning Mines, Northern Cape, South Africa. Source: Mindat; photo: Weinrich Minerals, Inc.

Streak.......................Pale yellow, orange, brown, white
Cleavage...................1 perfect
Luster........................Vitreous, greasy

Acknowledgments

I am grateful to Dr. Bruce Cairncross for responding to my questions and offering his insights and resources. He is an authority on the minerals of South Africa with extensive publications and presentations on this mineral-rich region. I am also indebted to our esteemed editor, Hutch Brown, who endures my missed deadlines and many revisions.

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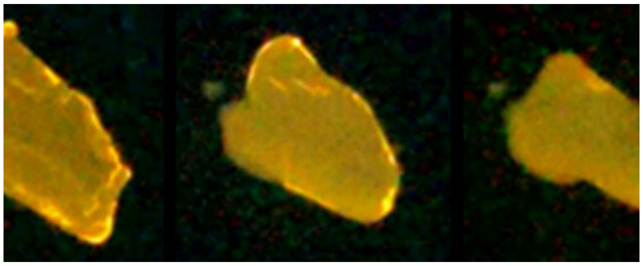


Strange Crystal Melts and Changes Color When Exposed to Light

by David Nield

***Editor's note:** The article is from Science Alert, 20 May 2023. Thanks to Tom Burke for the reference!*

A team of chemists from Osaka University in Japan has identified a rare property in a crystal. When exposed to the cool glow of ultraviolet light, the solid organic material transforms into a liquid.

What's more, this crystal undergoes an interesting series of changes in its luminescence as it melts, which points to changes in the structure of the crystal at a molecular level.

Though unusual, it's not the first substance found to undergo what's known as photo-induced crystal-to-liquid transition. But being able to study the transition using light could help scientists understand it better, potentially opening up a whole range of potential uses in photonics, electronics, and drug delivery. … *Read more*.

Quartz: What's in a Name?

by Hutch Brown

The term "quartz" comes from *Quarz* in German (pronounced "kvahrts"), the origins of which are unclear. Some sources claim that *Quarz* means "hard" in German, but it doesn't. The only term for "hard" I ever heard while living and studying in Germany for many years was *hart* (an English cognate—English is a Germanic language).

The confusion stems from the Oxford English Dictionary, which traces *Quarz* in German to *kwardy* (now *twardy*) in Polish, meaning "not easy to break." The term *Quarz*, perhaps borrowed from the Polish mining industry, would seem to reflect quartz's exceptional hardness (7 of 10 on the Mohs scale).

The German version of Wikipedia gives two alternative explanations. One, echoed by Mindat, is that *Quarz* comes from the mining industry in Saxony's *Erzgebirge* (Ore Mountain Range) in central Germany. Saxon miners derived the term *Quertz* from the original *Querkluftertz* (cross-fissure ore), referring to the relatively small quartz veins that were richest in silver. By the late 1700s, *Quertz* had become *Quarz*.

Another explanation is based on the language spoken in medieval Germany, when *querch* (now *Zwerg*) meant "dwarf." In German folklore, dwarves lived in the mountains, where they mined the rock for precious metals (hence the folktale "Snow White and the Seven Dwarves"). Transfer of the term *querch* to the mineral quartz reflected the related belief in mischievous *Berggeister* (mountain spirits) who stole valuable metals such as silver from the rock and replaced them with worthless quartz.

Chris Haefner

Intriguing Fossils From the 514-Million-Year-Old Kinzers Shale

May 6 Program

Our May speakers, Chris and Cathy Haefner, will deliver a Zoom presentation on fossils from Cambrian shale more than half a billion years old. The dark brown shale is from the Kinzers Formation, exposed in a railroad cut near the town of Kinzers in Lancaster County, located in southeastern Pennsylvania. The Kinzers, known for trilobites, is considered the most fossiliferous formation in southeastern Pennsylvania.

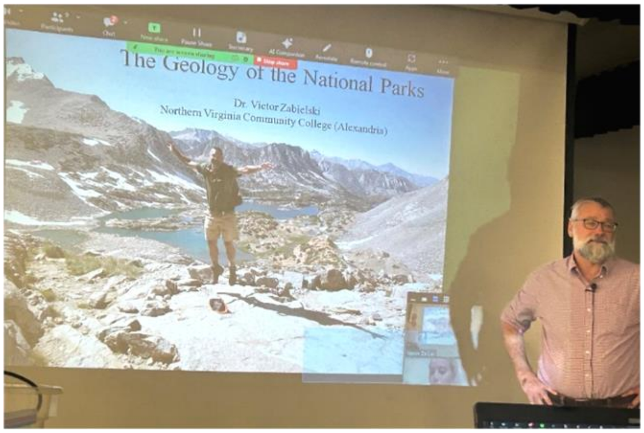
Chris Haefner is the founder of the Lancaster County Fossil and Mineral Club and a field geologist who specializes in collecting specimens for science. He has found new fossils that reside in museums around the world. Come to the May 6 meeting at the Dunn Loring Fire Station to see what he and his wife Cathy have found in southeastern Pennsylvania!

President's Collected Thoughts

by Jason Zeibel

Wow, this spring has flown by! It went from cold and windy to lie-out-by-the-pool weather in about a week at our house. We also just started fourth quarter at school—so, in addition to the beautiful weather that is calling us outside, it is time to buckle down and get grades up before the end of the school year. It will be over all too quickly, but for now I'm moving at the pace of a teenager or two to keep up with school schedules.

Our family had the wonderful opportunity to go with the club to the Luck Stone Quarry in Culpeper, VA, in late March (see the photo below of Lyra and Celia Zeibel behind dinosaur tracks circled in blue paint). A big shoutout to Katy and the Johnsons for organizing this trip to a spot that is otherwise open to the public just once a year! I was struck by how much erosion has already affected the footprints, and I'm glad that several were sliced out and taken to indoor spaces to be preserved. I was also struck by the sheer number of footprints in that layer of shale. A close look shows hundreds of spots with likely additional footprints—it must have been a very busy place 200 million years ago! It makes me wonder what else lies a few hundred feet below the surface that may or may not be discovered some day. It was also nice to see such a large turnout by our club, with 25 to 30 folks showing up.



The club was fortunate to welcome Dr. Victor Zabielski from the Northern Virginia Community College Geology Department to our meeting in April. Dr. Zabielski presented a very interesting in-person talk on the geology of the national parks. I found it fascinating to learn how three iconic western parks (Bryce Canyon, Zion Canyon, and the Grand Canyon) have interrelated geologies. Dr. Zabielski also pointed out places in our national parks where you can see older rock sitting on top of younger rock. For example, thrust faulting at Glacier National Park in Montana has placed pre-Cambrian layers onto much younger Cretaceous rocks.

Please continue to keep an eye out for good speakers, and send a note to our club VP, Craig Moore, who has the difficult job of coordinating all of our speakers. If you have a topic that you are excited about and feel motivated to present on it, then let Craig know!

Our family traveled to Dallas, TX, in early April. We visited some dear friends to experience the total solar eclipse on April 8. However, we planned to do a lot more than see the eclipse, especially since the weather forecast for clear skies was very iffy.

We took in the Perot Museum of Science and Nature, which has been there for about 10 years; this was our second visit, and this time we planned to spend more time in two amazing Earth sciences permanent exhibits: the Rees-Jones Foundation Dynamic Earth Hall and the Lyda Hill Gems and Minerals Hall. The Dynamic Earth Hall has a modern interactive set of exhibits that include an earthquake simulator; a description of the geologic epochs; and a display of the geology of Texas (fig. 1, top). The Gems and Minerals Hall has quite a few specimens to oooh and ahhh over, with a quality that would be at home in the

Figure 1—*Displays at the Perot Museum of Science and Nature in Dallas, TX, including the geology of Texas (top) and specimens on exhibit at the Lyda Hill Gems and Minerals Hall (bottom). All photos: Jason Zeibel*.

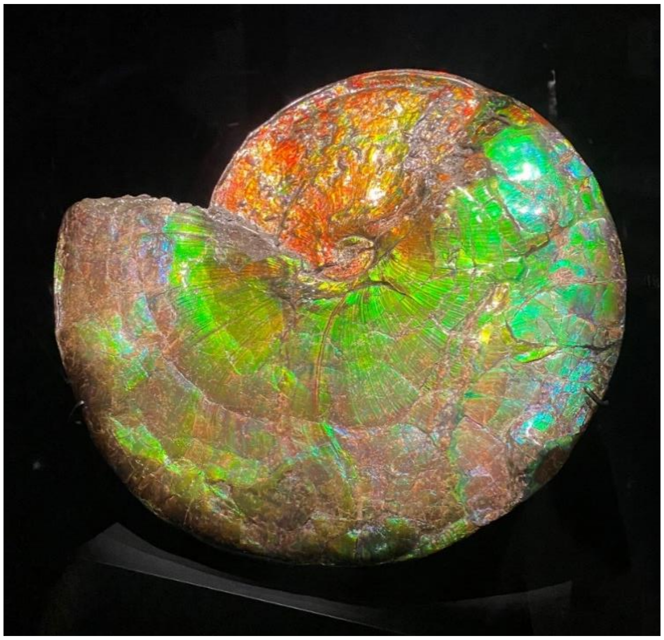


Figure 2—*Displays at the Perot Museum of Science and Nature include the Lavinsky Ammonite, a shelled cephalopod more than 2 feet in diameter.*

Smithsonian Institution exhibit (the bottom photo in figure 1 gives you some idea). The Eyes of Africa specimen is a quartz-and-green-fluorite specimen the size of the trunk of a car; it was shipped out of Namibia wrapped in 400 diapers. The hall is also the home of the Lavinsky Ammonite (fig. 2), an iridescent shelled cephalopod that is over 2 feet in diameter; the enormous "grape jelly" amethyst geode, nearly 12 feet tall; and a pair of gold nuggets with a combined weight of over 110 pounds.

As if our time exploring the Perot Museum wasn't enough, we were able to see this year's total eclipse while there. The museum had scientists from NOAA and the National Science Foundation who made sure that the local fauna were protected while viewing the eclipse (fig. 3). Of course, we made sure that our own family was also safe and well protected.

I did fly a couple of tripods and Nikon cameras out there, along with my 1.4x teleconverter and a Thousand Oaks Optical Solar Filter for my 600-mm Nikkor lens (fig. 4). Fortunately for us, the clouds held off for most of the day, and we were all able to see an amazing spectacle of nature and come home with some pretty amazing pictures of the eclipse.

Figure 3—*Viewing the April 2024 eclipse at the Perot Museum of Science and Nature in Dallas, TX.* **Top:** *Museum scientists took no chances that the local fauna might suffer retinal damage from staring at the sun during the eclipse.* **Bottom:** *The Zeibel family was well protected while awaiting the totality on April 8.*

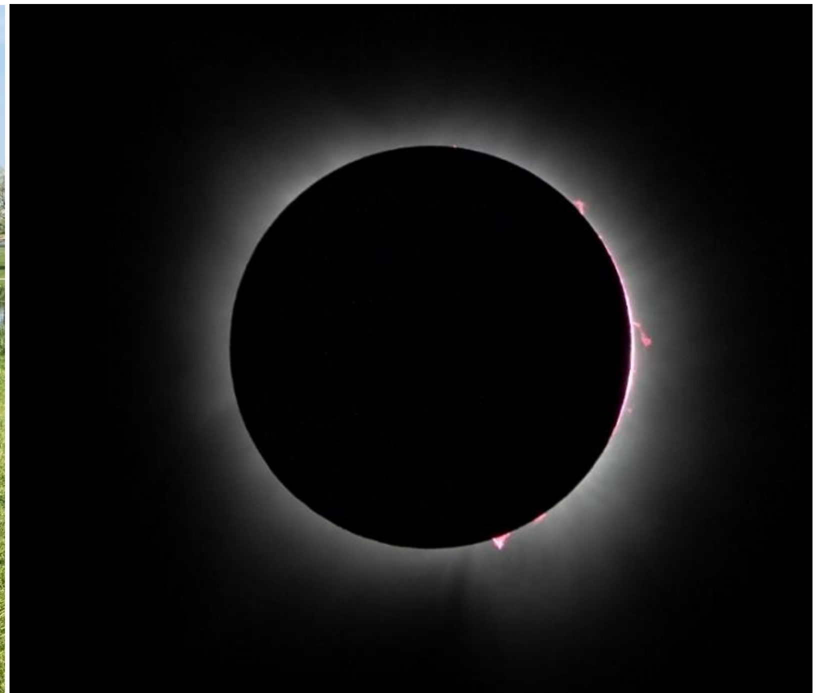


Figure 4—*The total solar eclipse on April 8, 2024, from near Dallas, TX.* **Left:** *NVMC president Jason Zeibel taking in the eclipse.* **Top:** *The solar disc, completely eclipsed by the new moon. Note the pink solar prominences that are each many times larger than Earth's diameter.*

In 2017, we were able to see the total eclipse in Kentucky, but this time the solar cycle was near a maximum, and there were some amazing solar prominences visible during totality (fig. 4, top).

Once again, I ask you to please consider bringing something for our Rock-n-Talk segment. Extra credit is offered to any of our young geologists. It doesn't have to be a long speech or cover the entire geologic history of the region—just a cool rock, mineral, or fossil and where/when you found it!

Please also try to bring a friend to the meeting.

Until then, go visit some of the amazing rock and mineral displays here locally or at some of the amazing museums and science centers around. Then you can go outside in the beautiful spring weather and imagine what it would be like to find something like that! ⛏

Jason

Arkansas Crater of Diamonds Find

By Emily Van de Riet

Editor's note: *The article is adapted from WKYT, 23 January 2024. Thanks to Sue Marcus for the reference!*

Julien Navas, while visiting from France, found a 7.46-carat brown diamond on January 11 at Crater of Diamonds State Park near Murfreesboro, AK. The diamond has a deep brown color and is rounded like a marble, about the size of a gumdrop. Park officials said it is the largest diamond found at the park since 2020 and the eighth-largest diamond found there since the area became a state park in 1972.

The park is one of the only places in the world where the public can search for real diamonds on the volcanic site where they were originally deposited. Navas plans to keep his find and have it cut into two diamonds, one for his fiancée and one for his daughter. *Read article.* ⛏

Meeting Minutes
April 1

by Almas Eftekhari, Secretary

President Jason Zeibel opened the meeting at the Dunn Loring Fire Station on April 1 by calling on visitors to introduce themselves. One visitor did so.

Jason acknowledged the problems with the email listserv in delivering the April newsletter to club members. Jason reminded us that we can always check the NVMC website to read the monthly newsletter.

Jason thanked Field Trip Co-Coordinator Katy Johnson for an awesome field trip to the Luck Stone Quarry in late March to see dinosaur tracks (see the article on page 14). Katy announced upcoming field trips, including one locally in May (see the announcement on this page) and another in June to Dinosaur Park in Maryland.

Vice President Craig Moore introduced Kathy Hrechka as a future speaker about her collecting adventures, saying she might bring some specimens (such as her collection of microdiamonds). Craig let everyone know that our June speaker will be Scott Duresky, who is scheduled to give a presentation on the Rutherford Mine in south-central Virginia. The Rutherford Mine is a renowned locality for amazonite.

Craig also announced that anyone wanting to join the club should see Treasurer Roger Haskins.

Jason reminded us that anyone can submit anything to Editor Hutch Brown for publication in the newsletter—even just a paragraph or a picture. It's an award-winning newsletter, so become part of it!

Jason invited members to share anything they'd brought for Rock-n-Talk, and he showed his own specimen of afghanite, a blue mineral. Another club member showed a specimen from Peru. Yet another featured a 30-million-year-old piece of petrified wood from Colorado.

Dr. Victor Zabielski from the geology department at the Northern Virginia Community College's Alexandria campus gave an in-person presentation on the geology of America's national parks. Members enjoyed his fascinating talk about our continent's plate tectonics and the various geologic formations that resulted.

Following the presentation, door prizes were announced. Shortly thereafter, the meeting was adjourned.

Field Trip Coming Up

Geology of Upper Accotink Creek

May 18, 2024

Our next field trip focuses on the upper part of a major watershed in Fairfax County, VA. Accotink Creek, 25 miles long, straddles two geologic provinces in our area, the Piedmont and the Coastal Plain. The stream originates just north of the city of Fairfax and crosses onto the Coastal Plain near Lorton, then joins the Potomac estuary near Gunston Hall (home of Founding Father George Mason).

Upper Accotink Creek traverses Piedmont bedrock roughly half a billion years old. We will meet at a small park near Fairfax city and walk to Accotink Creek, where we will see outcrops of metamorphic bedrock. We will also examine gravel bars along the creek for quartz in various hues and for fine-grained, greenish-gray pieces of bedrock with a micaceous sheen, such as phyllite and metasiltstone. Club members will lead the trip, explaining the origins of the bedrock, its context within the geology of our area, and the general history of the creek itself.

When: Saturday, May 18, 10 a.m. (rain date: May 19)

Where: Country Club Hills Commons Park, 10050 Spring Lake Terrace, Fairfax, VA (from Route 29, take Blenheim Boulevard towards Fairfax city, then right on Brookwood Drive and left on Spring Lake Terrace; park on the street)

The walk to the creek is short, but the vegetation is dense, so wear appropriate clothing, such as long sleeves and pants; consider using bug spray. The creek is small but has no bridges and we will cross it, so wear rubber boots (or other foot gear that you don't mind getting wet).

See you there!

A Billion Years of Geologic History Is Missing From the Grand Canyon

by Stephanie Pappas

Editor's note: *The piece is adapted from LiveScience (26 August 2021).*

The Grand Canyon is a layer cake of geologic history, with rocks stacked neatly upon one another as they were laid down millions of years ago. That is, until you get deep into the canyon and find the Great Unconformity, a gap between rock layers representing a billion years in some places.

Even stranger, the Great Unconformity shows up in rocks worldwide—and always in rocks from the same era: about 550 million years ago and earlier. …

Now Barra Peak, a doctoral student in geology at the University of Colorado in Boulder, and her colleagues have found an explanation. In the Grand Canyon, these rock layers were lost during a tectonic upheaval caused by the breakup of a supercontinent. The findings suggest that, although the Great Unconformity is found in rocks around the world, the reason for its presence might be different in every place. … *Read more*.

A Sulfur Cave in Colorado Is a Site of Scientific Discovery

Editor's note: *The article is the transcript from a show on National Public Radio on 15 May 2023. Thanks to Tom Burke for the reference!*

In Steamboat Springs, CO, there's a rare sulfur cave where people are normally forbidden to go. But Aaron Scott, the cohost of NPR's science podcast "Short Wave," recently got a chance to go in.

Sulfuric acid drips from the ceiling of a cave in Steamboat Springs, and the air is so full of toxic fumes that people are typically forbidden to go inside. Aaron Scott, the cohost of NPR's science podcast "Short Wave," grew up nearby and dreamed of exploring the cave as a kid, thinking it might be full of monsters and treasure.

So when he heard about a team of scientists going in, he couldn't pass up the chance to join them. We're going to turn it over to Aaron and "Short Wave" cohost Emily Kwong to find out why this sulfur cave has become a fascinating site for scientific discovery. … *Read more*.

Earthquake Rattles Northeast

Adapted from The Washington Post *(5 April 2024)*

A 4.8-magnitude earthquake struck northern New Jersey on Friday, April 5, producing tremors that were felt in New York City and as far away as Maryland and Massachusetts. It was not immediately clear what triggered the earthquake. It occurred in the Piedmont geologic province; because the Piedmont contains relatively old and dense rock, its shaking spread across hundreds of miles.

Whatever caused the quake, it is unlikely to be anything of great geologic significance, said Leslie Sonder, an associate professor of Earth sciences at Dartmouth University in New Hampshire.

The part of northern New Jersey where the quake occurred contains what David Wunsch, the Delaware state geologist and a University of Delaware professor, called failed rift valleys—places where a continent began to split apart hundreds of millions of years ago, leaving fault lines behind.

"It may be some readjustment related to that," he said.

Another potential cause could be tens of thousands of years in the making. Since glaciers disappeared from North America, the loss of ice on top of the continent has been causing much of the East Coast to slowly rebound. That change in stress causes earthquakes over time, Sonder said.

March Field Trip

Dinosaur Tracks in an Ancient Lakebed

by Katy Johnson, Field Trip Co-Coordinator

On Thursday, March 29, more than 20 NVMC members of all ages visited the Luck Stone Quarry in Culpeper, VA. We were there to view tracks—what geologists call trace fossils—left in the rock by dinosaurs hundreds of millions of years ago.

We met in the parking lot. After a safety briefing, our cars were led into the quarry, descending some 250 feet below ground level. We parked and walked along a path to a flat rock surface to marvel over tracks left by long-gone creatures—not just footprints but also one distinct belly impression. Most of the tracks were circled in blue paint, but one club member located an unmarked print.

With thousands of tracks, the quarry is home to one of the largest collections of dinosaur trace fossils in the world. The rock in the Luck Stone Quarry is mostly sedimentary siltstone, with particle sizes grading down to shale and up to fine-grained sandstone. The quarry crushes the stone into aggregate for construction.

The rock originated about 210 million years while the ancient supercontinent of Pangaea was breaking up. As proto-Africa pulled away from proto-North America, great rift valleys formed. The largest in Virginia, known as the Culpeper Basin, had rivers and shallow

lakes below a line of steep ridges—very much like the rift valleys of East Africa today.

Erosion washed sediments from the ridge lines into the basin, covering lake bottoms with silt. Dinosaurs wandering along the shore of a lake left tracks in the mud; much like basalt, the drying mud formed hexagonal cracks while also preserving the dinosaur tracks. As deepening sediments gradually filled Culpeper Basin, they hardened under pressure into rock.

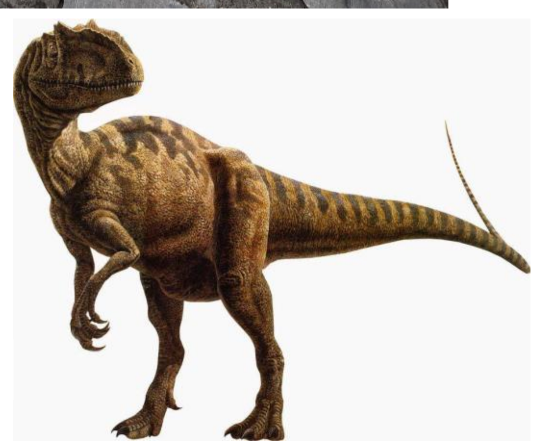
In May 1989, a quarryman discovered trace fossils in the ancient lakebed as workers prepared a new and deeper level of the quarry floor for blasting.

"We were pumping the water, and the water washed across the new floor, and the sun had evaporated the water on the top layer," he recalled. "But it was still wet inside the footprints, and I saw 17 of them in a straight line."

The quarry notified USGS of its discovery. Since then, scientists have identified more than 4,800 dinosaur tracks at the site, including those of *Kayentapus*, *Grallator*, and *Aetosaurus*. Some of the footprints are exhibited at the Smithsonian Institution's Museum of Natural History.

But most of the dinosaur tracks can be seen only by visitors to Luck Stone Quarry, and we deeply appreciate the opportunity! In particular, we owe thanks to plant manager Warren Paulson for coordinating our visit and to Robert Smith and Ted Robertson for guiding us into the quarry.

For more on the discovery of dinosaur tracks at Luck Stone Quarry, click [here](). ⛏



Kayentapus

Iceland's Fire and Ice

by Kathy Hrechka

I recently returned from a geological tour of Iceland with Patricia Baldwin, my friend of 40 years.

On March 22, my morning routine in Iceland shifted to viewing lava flows in real time from footage by a drone pilot in Iceland named Isak Finnbogason. Isak has been documenting eruptions on Iceland's Reykjanes Peninsula since December 2023; his documentaries are archived on Youtube.

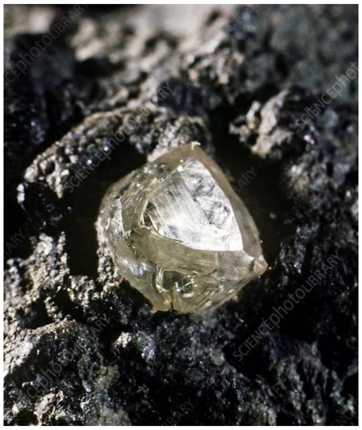
I took screen shots of Isak's live footage for this article. You can follow Isak on Youtube and X to learn about Iceland's volcanic eruptions.

Lava (upper right) approaching the town of Grindavik on Iceland's Reykjanes Peninsula on January 24, 2024.

"World's latest rock art." Aerial view of lava flowing in slow motion on March 24 while solidifying into basalt.

Fire and ice. **Top:** *Pat Baldwin and Kathy Hrechka enjoying Iceland's Blue Lagoon geothermal spa on February 21, 2024. The water temperature was over 98 °F and the air temperature was below freezing.* **Bottom:** *A fissure eruption started on March 16 between Hagafell and Stóra Skógfell, two hills near the town of Grindavík in southwestern Iceland. The eruption forced the evacuation of the Blue Lagoon spa.*

Aerial view of five cinder cones erupting on March 24.



Diamonds Reveal the Lost History of Supercontinents

by Stephanie Pappas

Editor's note: *The article is from* LiveScience, *14 January 2024. Thanks to Sue Marcus for the reference!*

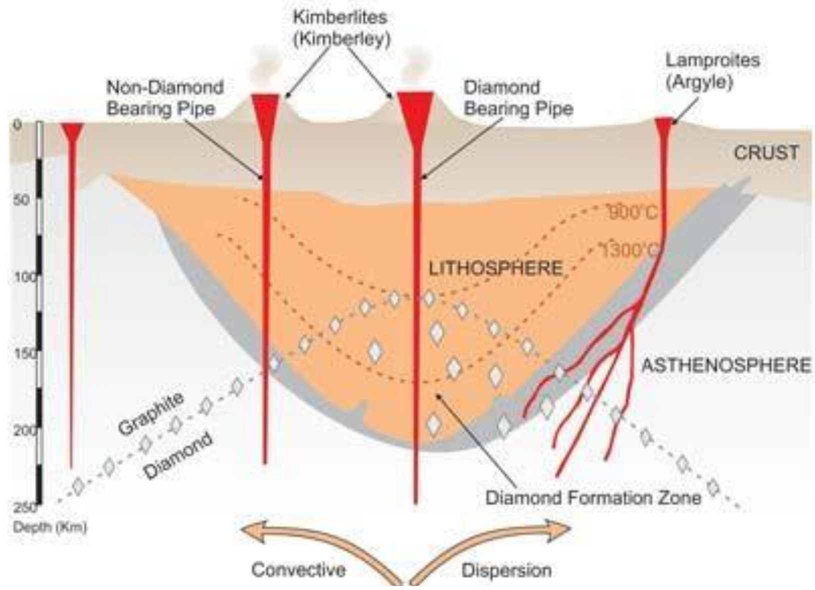
In the twilight of the Cretaceous Period 86 million years ago, a volcanic fissure in what is now South Africa rumbled to life. Below the surface, magma from hundreds of miles down shot upward as fast as a car on the autobahn—if that car were barreling through solid rock—chewing up rocks and minerals and carrying them toward the surface in a reverse avalanche.

What this looked like on the surface is lost to history, but it may have been as dramatic as the eruption of Mount Vesuvius in 79 CE. What it left behind was a series of carrot-shaped, igneous-rock-filled tubes under low, weathered white hills.

In 1869, a shepherd's discovery of a huge sparkly rock on a nearby riverbank would catapult this unassuming landscape into fame. The rock was an enormous diamond that would eventually be known as the Star of Africa, and the white hills hid what would become the Kimberley Mine, the epicenter of South Africa's diamond rush and quite possibly the largest hole on Earth ever dug by hand.

Thanks to the Kimberley Mine, often called "The Big Hole," the formations where diamonds are found are now known as kimberlites. The formations are sprinkled around the globe, from Ukraine to Siberia and Western Australia, but they're relatively small and rare. What makes them special is that their magmas come from very deep down. There are still questions about precisely how deep, but they are known to arise from beneath the bases of continents at the border of the hot convecting mantle. Some may originate even deeper, at the transition between the upper and lower mantle.

As such, these magmas tap into very deep, very ancient rock, and they interact with other processes that occur only in the deep Earth—namely, the formation of diamonds. To crystallize plain old carbon graphite into hard sparkly diamond requires great pressure, so these gems form at least 93 miles down, in the deepest layers of the lithosphere, the scientific term for the crust and the relatively rigid upper mantle. Some, known as sublithospheric diamonds, form even deeper, down to about 435 miles. Kimberlites, on their eruptive journeys to the surface, catch diamonds and drag them into the upper crust, delivering them relatively unscathed and sometimes even containing pockets of fluid from the mantle itself.



Diamonds form from graphite (carbon) under tremendous heat and pressure many miles underground, where they "float" as solids in superheated viscous magma. Violent volcanic eruptions of magma from the diamond zone can carry diamonds in kimberlite or lamproite matrix to the Earth's surface. During the Cretaceous Period, a diamond-bearing lamproite eruption occurred in what is now Arkansas, forming today's Crater of Diamonds; the eruption is thought to be an aftereffect of the breakup of the supercontinent Pangaea beginning about 230 million years ago. Crater of Diamonds is one of the few diamond-bearing pipes in North America, though others have been found on the Rocky Mountain Front Range in Colorado and Wyoming.

Researchers have long known that as tectonic plates grind under one another, they drag down carbon from the surface to depths where it can crystallize into diamond. Now they're starting to see that what goes down must (sometimes) come up and that this reappearance of carbon—now pressed into glittering gems—is also tied to the movements of tectonic plates. In particular, diamonds seem to erupt when supercontinents break apart. … *Read more*.

The Rocks Beneath Our Feet

Some Lava Types on Maui, Hawai'i

by Hutch Brown

My wife Kathryn Funk and I recently spent time near where she grew up on the Hawaiian island of Maui (fig. 1, top). We visited Wailea and Makena in South Maui and explored the spectacular Kapalua coastline of West Maui between Makaluapuna Point and Hawea Point (fig. 1, center/bottom left).

Both points are ancient lava flows about a quarter mile long. On both, I noticed two types of lava (there could have been more) that were side by side yet very different. I took photos and did some research to help me understand what I saw.

Geologic Setting

The Hawaiian Islands are oceanic volcanoes rising up to 30,000 feet or more from the Pacific seafloor. The volcanoes formed a line over millions of years as the Pacific Plate passed over a hotspot of magma rising from the Earth's mantle. Each volcano went through a "shield phase" of eruptions lasting about a million years, followed by a "postshield phase" as the island moved away from the hotspot and stopped erupting altogether.

Maui comprises two volcanoes. The younger volcano, Haleakalā, is still in the postshield phase, erupting as recently as 400 years ago. The West Maui Volcano, now extinct, is about 2 million years old, with postshield eruptions ending about 320,000 years ago. The volcano has eroded into a series of valleys and peaks up to about 5,800 feet in height (fig. 1, bottom right), locally known as the West Maui Mountains.

Most of West Maui is made up of what geologists call Wailuku basalt from shield-phase lava flows; a simplified geologic map shows the basalt in olive (fig. 2). Later eruptions in the postshield phase placed younger lavas (the Honolua and Lahaina volcanics, aqua and purple on the map) over the shield-phase flows. The Kapalua lavas (fig. 2, arrow) originated during the postshield phase, comprising some of the last lava flows on the West Maui Volcano.

Lava Flows

Compared to our area, with its billion-plus years of tectonic history and its enormous geological complexity, the Hawaiian Islands are simple; everywhere

Figure 1—*Top:* *Location of Kapalua, Wailea, and Makena on Maui.* ***Center:*** *Hawea Point in the distance, with lava rock on Makaluapuna Point in the foreground.* ***Bottom left:*** *Location of Kapalua's lava peninsulas.* ***Bottom right:*** *West Maui Mountains. Photos: Hutch Brown (center); Wikipedia (bottom).*

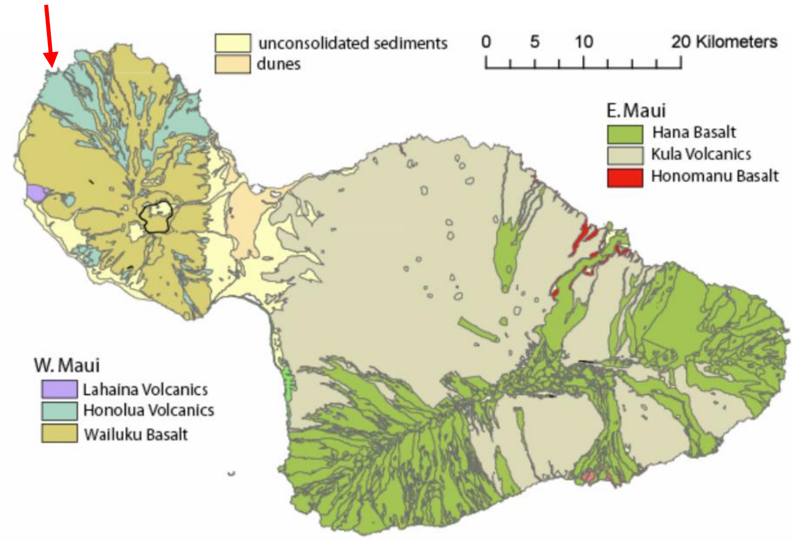


Figure 2—*Simplified geologic map of Maui. The arrow shows Kapalua on West Maui. Wailuku basalt (olive) is from the shield phase, with the overlying Honolua and Lahaina Volcanics (aqua and purple) comprising lava flows from the postshield phase. Source: Sinton (2006).*

Figure 3—*A'ā flow resulting in fields of scoria from Haleakalā's last eruption about 400 years ago, with Kathryn Funk for scale. The lava came from a vent on the volcano's southwestern flank above the South Maui area called Makena.*

you go, you see almost nothing but lava. It took me a while to realize that not all lava is the same and that the differences can be striking.

Lava flows usually come in two kinds—aʻā and pāhoehoe (pronounced AH-ah and pah-HOY-hoy). Pāhoehoe is a Hawaiian term meaning "smooth;" pāhoehoe flows are the hottest, making them viscous—thick and sinuous, oozing rather than flowing and cooling into a smooth and ropy lava rock.

Pāhoehoe transitions into aʻā when the lava temperature drops below 1200 °C and the flow becomes more liquid. The lava fountains and rivers familiar from videos of Hawaiʻi are aʻā, which made up most of the shield flows on the Hawaiian Islands.

Both pāhoehoe and aʻā flows usually (but not always) cool into black lava. Aʻā usually (but not always) becomes jagged and vesicular (filled with holes) from gas bubbles trapped in the rock, a lava type known as scoria. Over time, scoria often turns reddish brown from oxidation (rusting) of its iron content. Haleakalā's youngest lava, for example, comprises vast fields of reddish-brown scoria along East Maui's southwestern coast near Makena (fig. 3).

Lava flows can also cool into basalt columns, smooth on top and cracking into hexagons as the lava dries. I saw signs of that along the coast near Wailea Point on the southwestern edge of Haleakalā (fig. 4), where the

Figure 4—*Lava near Wailea Point on the southwestern edge of Haleakalā in South Maui. Almost all of the lava in the area is black. Smooth surfaces with cracks forming hexagonal shapes (circled) are typical of basalt as it cools. Photo: Hutch Brown.*

basalt has remained almost entirely black, with little reddish-brown rust.

In addition to a‘ā and pāhoehoe, lava flows can come in what geologists call blocks. Block lava is highly viscous (sticky and oozing rather than flowing), forming mounds and breaking into angular chunks of various sizes and into plates at odd angles. Block flows are common in lava that is more than 55 percent silica by weight (such as andesite, dacite, and rhyolite).

Lava Types

Geologists classify lava types based on the minerals they contain, specifically the comparative amounts of silica (SO_2) and alkali ($Na_2O + K_2O$) minerals. Silica is quartz; alkali minerals include orthoclase, albite, and more. Most lava on West Maui is basalt, which—according to the USGS sources I used (Sherrod and others (2021, 2022))—contains, by weight, 45 to 52 percent silica and 5 percent alkali minerals. Basalt flows are usually (but not always) a‘ā.

The Honolua volcanics, including the rocks on Kapalua (fig. 5), are outliers. Though described as a‘ā, they are not basalt but rather types of lava called benmoreite and trachyte. Both lava types are, by weight, 57 to 63 percent silica and 6 to 12 percent alkali minerals, with benmoreite at the lower and trachyte at the upper end of both mineral components. Their high silica content makes them analogous to andesitic lava flows—highly viscous, with the consistency of peanut butter. They might start out as a‘ā, then transition into blocklike flows.

Figure 5—*Lava on Kapalua's Hawea Point ranges from a smooth and sinuous light gray benmoreite to a vesicular dark gray breccia (with embedded rocks). The breccia partially overlies the benmoreite, suggesting a later lava flow. Photo: Hutch Brown.*

Wikipedia uses the Dragon's Teeth formation on Kapalua's Makaluapuna Point to illustrate benmoreite lava, which came from a vent about 6 miles uphill. Benmoreite's light gray color and smooth, sinuous texture (fig. 5) derive from its high silica content. So does benmoreite's tendency to form mounds, angular blocks, and upturned plates (fig. 6), including the unusual lava spires of Dragon's Teeth (fig. 7).

The platelike structures are upturned because silica-rich lava is so viscous, oozing rather than flowing and sticking together in plates pushed up by liquid lava before cooling. Lava on the edge of Haleakalā in

Figure 6—*Upturned plates, mounds, and angular blocks of benmoreite on Kapalua's Hawea Point. The arrows show examples of each; all resulted from viscous lava as it cooled and partially solidified while oozing toward the sea. Photo: Hutch Brown.*

Figure 7—*Dragon's Teeth, an unusual formation of upturned lava plates on Kapalua's Makaluapuna Point, with Kathryn Funk for scale. Photo: Hutch Brown.*

Figure 8—*Upturned plates of basaltic black lava with "teeth" (arrows) at the edge of Haleakalā on Wailea Point in South Maui. Photo: Hutch Brown.*

South Maui, known to geologists as the Hana basalt, also formed upturned plates with "teeth" (fig. 8, arrows), possibly because the free-flowing basaltic a'ā became much more viscous as it cooled.

In addition to the light gray benmoreite of Dragon's Teeth, Makaluapuna Point has a "rubbly material … that appears to represent intra-flow breccias" (Sinton 2006). Neighboring Hawea Point has the same combination of benmoreite and "rubbly material." The dark rock in figure 5 appears to be an overlying volcanic breccia, possibly from an eruption that was both explosive and productive of highly viscous flows.

Figure 9 shows examples of volcanic breccia on Hawea Point. Both resemble sedimentary conglomerate as well as its volcanic counterpart, agglomerate. The embedded rocks often fall out of the weathered matrix, forming a rocky rubble.

Volcanic breccia originates when oozing viscous lava breaks off in chunks of various sizes. The oozing flow then reincorporates the chunks and mixes them in with the remaining liquid magma, where the pieces solidify as rocky inclusions within the lava matrix. Lava might also flow over preexisting rocky rubble and incorporate it as angular chunks.

If the lava vent is explosive—as silica-rich magma often is—then the eruption hurls lava bombs and spatters ("tephra") into the sky. The tephra are cooled and rounded as they fly through the air. Landing in the viscous lava flows, they are incorporated into the oozing mass, adding rounded rocks to the lava matrix.

Figure 9—*Volcanic breccia on Kapalua's Hawea Point. The breccia incorporates angular chunks from viscous lava flows as well as rounded lava bombs. (The reddish-brown color in the lower photo is from iron oxide.) Photos: Hutch Brown.*

Rich Volcanic Record

The Hawaiian Islands are more than just a series of volcanic eruptions leaving relatively young basalts. The postshield flows in particular comprise lava types that are richer than basalt in silica and/or alkali minerals—lavas like basanite, hawaiite, and more.

On Maui, the postshield flows can have unusual features. The most dramatic are the lava spires of Dragon's Teeth on Kapalua's Makaluapuna Point, which have long puzzled observers. They are not—as one guidebook claims—shaped by high winds and waves; rather, they are upturned plates—"near-vertical flow folia," as one source calls them (Sinton 2006)—from highly viscous and therefore blocklike benmoreite flows with counterparts elsewhere in Kapalua (fig. 6).

In addition to Dragon's Teeth, Kapalua has another prominent lava feature—the volcanic breccia that partially overlies the light gray benmoreite. Kapalua's lava types made me realize that Hawai'i's volcanic record is richer and more varied than I had thought.

Erratum

My explanation of Kapalua's Dragon's Teeth in the November 2022 issue of this newsletter was misleading. Dragon's Teeth appears to have formed from block flows of highly viscous lava, not from the effects of high winds and waves on a river of lava, which would have been unlikely in the oozing postshield flows along the Kapalua coast. Of course, high winds and waves on Makaluapuna Point would have contributed to the weathering that later shaped the plates into toothlike spires. ⛏

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Dragon's Teeth on Kapalua's Makaluapuna Point, with Kathryn Funk for scale. Photo: Hutch Brown.

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Suddenly, Bobby felt very alone in the world.

May 2024—Upcoming Events in Our Area/Region (see details below)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1 MSDC mtg	2	3	4 Show: Pittston, PA
5 **Cinco de Mayo** Show: Pittston, PA	6 **NVMC mtg**	7	8	9	10	11
12 **Mother's Day**	13 GLMSMC mtg	14	15	16	17	18
19	20	21	22 MNCA mtg	23	24 Show: Salem, VA	25 Show: Salem, VA
26 Show: Salem, VA	27 **Memorial Day**	28	29	30	31	

Event Details

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

4-5: Pittston, PA—Annual show; Mineralogical Society of N.E. Penna; Oblates of St. Joseph Seminary, 1880 Hwy 315; Sat 10-5, Sun 10-4; admission $3, children free with adult; info: George Walko, 570-200-5987, Anthracitecoin@gmail.com, msneps.org.

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

13: Rockville, MD—Gem, Lapidary, and Mineral Society of Montgomery County; info: https://www.glmsmc.com/.

22: Arlington, VA—Micromineralogists of the National Capital Area; info: http://www.d centimeter-sicrominerals.org/.

24-26: Salem, VA—Annual show; Salem Gem, Mineral and Jewelry Show; Salem Civic Ctr, 1001 Roanoke Blvd; Fri 10-6, Sat 10-6, Sun 11-4; 18+ $8, 11-17 $2, 10/under free; info: Alan Koch, agmjs3@gmail.com, www.americangemshow.com.

Sturmanite, N'Chwaning Mines, Northern Cape, South Africa. Source: Mindat; photo: Rob Lavinsky.

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OR

Bring your dues to the next meeting.

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

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

Meetings: At 7:30 p.m. on the first Monday of each month (except January and September) at the Dunn Loring Fire Station, 2148 Gallows Road, Dunn Loring, VA.* (No meeting in July or August.)

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