



*The Mineralogical Society of the  
District of Columbia*



# ***THE MINERAL MINUTES***

*Vol. 76, No. 3      Founded 1942      March 2017*

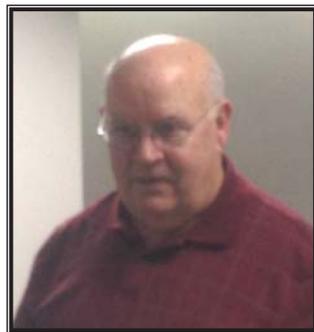
- March's Meeting is Wednesday, 1 March. We will be meeting at 7:45pm in the lobby of the Museum of Natural History. Dinner at the Elephant and Castle at 6pm for those interested in dining beforehand.

## **IN THIS ISSUE:**

The Prez Says...	Page 1
March Program – “Copper Silicates of Arizona”	Page 2
Minutes of the January Business Meeting	Page 3
February 2017 Program “The Mysterious Stone Faces of Teotihuacan”	Page 4
The Rocks Beneath Our Feet - Theodore Roosevelt Island: The River	Page 6
Mineral of the Month – Native Silver	Page 12
Geologist of the Month – James Hutton	Page 14
Mineralogical Society of America Editors' Picks	Page 17
Useful Mineral Links	Page 19
Upcoming Geology Events	Page 19
AFMS Code of Ethics	Page 21

## **The Prez Says...**

By David Nanney,  
MSDC President



**T**ucson was a blast. I cannot recommend too strongly, that visiting Tucson during their Gem and Mineral Show should be on any mineral collectors bucket list. We started this year by meeting our web master, Casper Voogt, at the Westward Look Resort. This is a high end show,

which normal mortals attend only to worship. Apparently Casper isn't normal, as he acquired an incredible vivianite which he proudly displayed for our lunch enjoyment. Leslie and I were only in awe.

We moved on to the Tucson Hotel (old Inn Suites) with a first day target to visit several familiar vendors. It turned out to be exactly like when we visit Keith Williams, they all remembered us, and they all enjoyed our visit. We exceeded our total 2016 Tucson visit spending on the first day. We are finally beginning to move some (not many) of our purchases towards the \$100 range, something we have strongly resisted.

Before it was all over, we acquired 26 pieces, three of which are for Missy Kate, and one for a mineral friend [Editor's Comment: It is good to have friends like Dave, but I don't think it is for me]. We seem to have emphasized the India minerals once again this year as they are both colorful and complicated.

This was a social year as we also met Joe Turnbow, formally owner of Natures Jewels, a mineral shop in Anchorage. He and his wife retired here and we got to share mineral lust with them. We also met Ken Zahn, formally a member of several local Maryland mineral clubs during his military days. He was (and is) the proponent for williamsite, a beautiful green variety of antigorite found in the serpentine deposits of Maryland, to be the Maryland state stone. He brought the carved williamsite dragon often seen as the illustrative figure. I'd vote for it. We first met Ken and Carol during our Yellowstone adventure, thanks to Sheryl Sims publishing his article in our own Mineral Minutes.

Callan Bentley, Associate Professor at the Northern Virginia Community College, has

## March Program – “Copper Silicates of Arizona”

Dave Hennessey

We are excited to welcome back our presenter for March, Michael Pabst. Michael made a previous presentation to MSDC on photomicrography techniques and wowed us with photographs of various micro-minerals in his collection. For many years, Michael studied and collected microminerals while working as a professor of biochemistry and immunology at the medical centers of the University of Colorado in Denver and the University of Tennessee in Memphis. He is now retired and continues to pursue his passion for photomicrography. Over the past several years, he has been researching and photographing various uranium minerals and has produced a number of articles featuring photographs along with descriptive information about their localities. In 2014, Michael won First

offered to field any, repeat any questions about science posed to him. It's his way of responding to some of the challenges to science that seem to be increasing. Coincidentally, he jumped right on Tim Rose's presentation about dating zircons. I am including the web address of his Mountain Beltway blog site, a great geologic read on any day. But this article on zircons addressed in great detail, yet almost readable, the use in dating the age of crustal masses. Callan's timing is excellent, and the article is well worth your time. <http://blogs.agu.org/mountainbeltway/2017/02/21/qa-episode-3/>

While Leslie and I won't be there for the March meeting, I understand the weather in DC recently, on many days, has matched the wonderful weather here in Arizona. Put it on your calendar that it usually snows just after we return on 1 April. See you at our April meeting and remember that we would love for you to join us for dinner with the speaker beforehand.

Place in the Adult Articles competition of the American Federation of Mineralogical Societies (AFMS) for his article "Fourmarierite" in The Mineral Mite for September 2013. Also in 2014, Michael won the "Trophy" award (highest award) from the Eastern Federation of Mineralogical and Lapidary Societies (EFMLS) for his original educational article "Becquerelite and Kasolite" in The Mineral Mite for November 2013. These Mineral Mite articles are available on the MNCA website: [dcmicrominerals.org](http://dcmicrominerals.org), under the Newsletter tab. Most issues of the Mineral Mite since September 2013 include an article by Michael Pabst.



Christmas Mine, Christmas, Christmas area, Banner District, Dripping Spring Mts, Gila Co., Arizona, USA. Field of view : 2,5 mm, Photo & Collection : J. M. Johannet. Source: mindat.org

Michael's March first presentation will be on "Copper Silicates of Arizona". This talk is an extension of an article, "Rare Silicates from the Christmas Mine, Banner District, Gila Co., Arizona", that appeared in the August 2016 edition of Mineral News. (Mineral News is "The Mineral Collector's Newsletter", published by Excalibur Mineral Corp. of Charlottesville.)

According to Mindat, there are 7 copper silicates found at the Christmas Mine, but there

## Business Meeting Report January 2017

Andy Thompson, Secretary

President David Nanney welcomed everyone, especially first-time guests Nicole and Will, as well as long-time MSDC friend Rebecca. After thanking former MSDC presidents in attendance, Dave highlighted Steve Johnson's excellent editorial work with the February issue of Mineral Minutes.

Under "Old Business" Dave Hennessey reported enjoying the annual field trip to James Madison University. Under "New Business" Steve Johnson displayed his newly created MSDC 75th anniversary tee shirt, replete with relevant

are 18 copper silicates found in Arizona, and 39 copper silicates found in the whole world. Copper silicates are some of the most aesthetic of minerals, featuring attractive crystals in wonderful blues and greens. Michael's presentation promises to be a feast for the eyes and an opportunity to learn more about the formation and habits of copper silicates.

(Note: More of Michael's photographs can be viewed at [http://www.shenandoahvalleyrockclub.org/links\\_resources/interest\\_groups/microminerals/microminerals\\_gallery.html](http://www.shenandoahvalleyrockclub.org/links_resources/interest_groups/microminerals/microminerals_gallery.html) and on his Mindat Homepage at <https://www.mindat.org/gallery-27958.html>.)

Please join us in taking Michael and his wife Karen to dinner on March 1st before the club meeting. We will be meeting at 6:00 pm at Elephant & Castle Restaurant, 1201 Pennsylvania Ave, NW, Washington, DC, about 2 blocks from the Smithsonian Institution National Museum of Natural History (NMNH) where our club meeting is held. If you cannot make it to dinner, we will meet in the NMNH lobby at 7:30 pm (Constitution Avenue-side lobby) from which we will head up to the Cathy Kerby Room for Michael's presentation.

graphics. President Nanney thanked Steve for this creative endeavor and said club members and the BOD will discuss possibly adopting this as an integral part of our celebration. Members also noted the upcoming Montgomery County Mineral Club's show which will take place March 18-19. Visit their website at [www.glmsmc.org](http://www.glmsmc.org) for more information.

Treasurer John Weidner gave an end-of-the-year report on MSDC's finances. For 2016 the club ran a small deficit which John said was not a near-term concern given the club's projected income and expenses for the next couple of years. A motion was made to accept the report as given and it received a unanimous vote of approval. Dave expressed his gratitude for John's careful work and reporting.

The V.P. for Programs, Dave Hennessey then provided an overview of MSDC's monthly programs: March -- Michael Pabst on the silicates of Arizona; April -- Jeffrey Post will share the most recent acquisition the Mineral Department obtained at Tucson mineral show; May -- S cott

## January 2017 Program Presentation "The Mysterious Stone Faces of Teotihuacan" by Tim Rose and Jane MacLaren Walsh

By Andy Thompson (Secretary)

**D**ave Hennessey, V.P. for Programs, introduced the evening's two presenters. Tim Rose, MSDC's sponsor, is a geology specialist of the Mineral Department at the National Museum of Natural History (NMNH), while Jane MacLaren Walsh is an anthropologist, also with the Smithsonian. They have worked as an interdisciplinary team to help solve the cultural and mineralogical puzzles surrounding the faces of Teotihuacan, previously misidentified as "masks."

Before starting their formal presentation, Tim updated attendees with breaking news on the Kilauea volcano's lava flow, about which, over the years, he had previously shared with us his personal experiences and research findings. That flow, which some Hawaiians believe to be the goddess Pele, has finally reached the ocean causing spectacular displays of steam, flying globs of lava, a dramatic rescue of visitors walking on the fragile crust, and an unusual "firehose" stream of lava. Tim recommended we search out the HBO website for the video dated 31 January 2017.

He also noted that the NMNH's new electron probe, which supported his and Jane's analysis of the minerals associated with the stone faces, will be the subject a future "field trip" for interested parties sometime down the road. Further information will appear in a future edition of this newsletter.

With regard to the evening's program, many are familiar with the TV hit program "CSI Miami"

Southworth of the USGS will present on a topic TBA. President Nanney expressed his appreciation for Dave's having lined up these very solid programs.

A motion was then made, seconded and approved to close the business meeting.

which ran for 12 years and focused on Crime Scene Investigations using high tech science and old fashioned police work. For me, tonight's presentation felt like it could have been named "CSI Teotihuacan," with Tim and Jane using the Smithsonian's new electron probe and their own on-site anthropological investigations-in Mexico to uncover numerous previously unsolved mysteries. Those include: Why were the faces found primarily at Teotihuacan and not throughout Mesoamerica? What were they made of, their mineralogy? Where were they carved? What was their purpose? Are the faces held in today's museums authentic or modern forgeries?

No synopsis can do justice to their forensics, tight reasoning and scholarly conclusions. But here are some of their salient findings.

- Tim and Jane carefully examined more than 130 faces currently held in 7 museums in North America and Europe. Earlier researchers believed the stone faces were made of jadeite. But our presenters, using a scanning electron microscope, documented the faces were made respectively of one of four rock types, either serpentine, travertine, limestone or listwanite. For the Teotihuacan locale, located north of present day Mexico City, researchers found none of those four minerals within 50 kilometers. Given the practical challenges of hauling heavy raw stone materials, Tim and Jane concluded the faces were made elsewhere, close to the source of the raw material. That is what the ancient people had to do in order to have plaster which they used in great quantities to cover their buildings interior walls for painting. The lumber and the burning of the limestone needed for making plaster, they reasoned, happened well beyond the city and only the finished product was transported to Teotihuacan as finished goods.

- An even stronger indication the faces were made elsewhere is the abundance of orange ware, beautiful iconic pottery which originated in Puebla's workshops, was transported to Teotihuacan and then redistributed throughout Mesoamerica. Archeologists have considerable evidence not only from the orange pottery artifacts unearthed in Puebla workshops, but also from evidence of the trade routes leading to and from Teotihuacan.
- Although anthropologists' excavations found evidence of the green and black obsidian workshops, they found no evidence of the orange pottery or lapidary stone carving being made in Teotihuacan. In Puebla, however, to the southeast, they not only evidence of ancient workshops and highly skilled craft products but also that the area also had an abundance of the four rock types of which the stone faces were made. Despite the probability of Puebla being the original carving site, without further data, the identity of the face makers remains a bit uncertain.
- Anthropologists' excavations found evidence Teotihuacan was the primary location for finding the faces even though a few were unearthed outside the city in nearby smaller towns. It was the most populated city in the New World, having as many as 200,000 residents. It was also the wealthiest city which some suggest was due to its two mines supplying the rare and highly treasured green obsidian. However, its inhabitants left behind no written records but rather a lot of destroyed buildings and unanswered questions for future generations. It thrived from about 100 BCE to 700 AD when the city was suddenly abandoned. The Aztecs arrived around 1200 AD and they named the city Teotihuacan, meaning "City of the Gods." The names of the three major pyramids, Sun, Moon and later the Feathered Serpent, also seemed to be Aztec in origin. But without any evidence of the original builders' written language, all those earliest names and meanings have been lost.
- Centuries of post-Columbian looting resulted in the faces' dissemination around the

globe. That happened before the modern rise of faking valuable ancient artifacts. Of those faces studied, only 3 were fakes, identified as such because microscopic analysis showed them as having telltale scratches that could only have been made by modern machinery.

- Early researchers misidentified the faces as "masks." But their heaviness, shape, lack of openings for seeing and breathing suggested the faces had different purpose. Anthropologists have uncovered quite a few free-standing two foot high structures in homes and buildings as well as larger, chest-high platforms. Their structure suggested they were used for the ritual purposes, including burning of incense. The faces had symmetrically placed holes into which were probably placed adornments such as colorful feathers. But because the adornments were made of perishable material, none survived. But broken remnants the smaller incense-burning structures were frequently found in people's homes. The faces, being more durable, survived their millennia-long burial and were probably associated with larger platforms or incense burners. One larger altar-like structure was found with a face on the ground in front of it. Tim and Jane suggested the faces could well have been used as center pieces of larger altar-like shrines.

Based on these break-through CSI-type reasoning, based on the gum-shoe, feet-on-the-ground discoveries and the insights gained from the various high tech forms of scanning the minerals, Tim and Jane have provided future researchers with greater clarity for unpacking these mysteries surrounding the faces of Teotihuacan and the culture which gave the faces an honored role in their ritual celebrations. After our presenters fielded MSDC members' questions, Dave Hennessey thanked our Smithsonian researchers for their very interesting and superbly documented illustrated presentation. The conversation continued in the presence of some of the actual ancient artifacts.

## February Show and Tell

Thanks to Ken Reynolds for sharing extraordinarily beautiful samples of his favorite mineral, barite, collected from overseas lands including Peru and Scotland. To behold a chunk of raw copper from Michigan, however, showing

## The Rocks Beneath Our Feet Theodore Roosevelt Island: The River

by Hutch Brown

Editor's note: This is the second in a three-part series on the geology of Roosevelt Island. This was originally published in the February edition of *The Mineral Newsletter* of the NVMC.



Theodore Roosevelt Island in 1950, from the north looking south. The main channel to the left, a river meander, is called the Georgetown Channel; the smaller channel on the right, on the Virginia side, is known as Little River. Source: National Park Service.

The Potomac River changes as it approaches Washington, DC. The relatively narrow and swift-flowing channel in Mather Gorge, a spectacular canyon to the northwest of the nation's capital, becomes a broad and lazy river barely above sea level, influenced by the tides. The Potomac begins to look like rivers around the world that drain broad flat plains, with wide meandering turns.

The initial turn is around Theodore Roosevelt Island on the Washington side of the river. It is called the Georgetown Channel; the smaller

a clear in-print of the excavation drill bit, was a new experience for most members. Dave thanked Ken for generously bringing his collectibles, and encouraged others to do the same.

channel on the Virginia side of the island is known as Little River.

## The Bedrock

The core of the island is a riverine high point in the basement rock that underlies the Piedmont in Virginia and Maryland. It is metamorphic rock, a metasedimentary melange known as the Sykesville Formation.

Sedimentary melanges typically originate in ocean trenches. They include sands, silts, and embedded rocks of various sizes. Mountain-building events metamorphose the melange, turning it into a gray crystalline rock rich in quartz.

The Sykesville Formation originated at least half a billion years ago, probably through the interaction of tectonic plates in the ocean that preceded the Atlantic. Over more than a billion years, the ocean in our area has opened and closed multiple times. The corresponding mountain-building events (what geologists call orogenies) have molded the geology of our area.



Outcrop of the Sykesville bedrock at the northern end of Theodore Roosevelt Island. Note the quartz grains and embedded rocks. Photo: Hutch Brown.

In particular, an event called the Alleghanian Orogeny beginning about 320 million years ago placed the Sykesville Formation where it is today. In the immediate vicinity of Theodore Roosevelt Island, the Sykesville also underlies North Arlington in Virginia and part of Georgetown in Washington, DC.

So we know what the bedrock is and how it got to where it is today. But that story ended with the Alleghanian Orogeny about 280 million years ago.

What has happened since? How did this particular slice of the Sykesville bedrock become an island?

## Pangaea



Figure 1—Map detail of our area (circled) as part of Pangaea about 290 million years ago. Proto-Africa is at lower right, proto-North America at upper left, with the Alleghanian Mountains covering the seam between them.

Source: Blakey (2011).

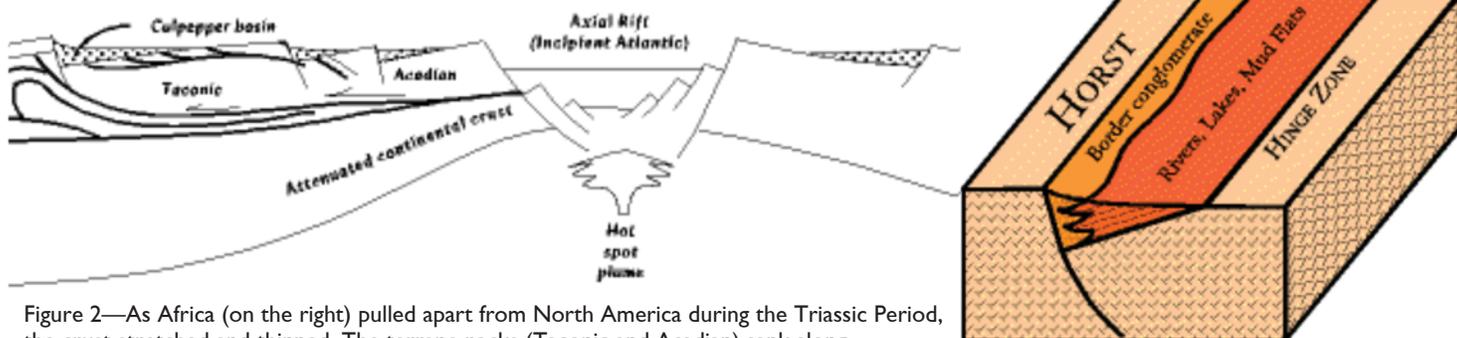


Figure 2—As Africa (on the right) pulled apart from North America during the Triassic Period, the crust stretched and thinned. The terrane rocks (Taconic and Acadian) sank along reactivated fault lines, forming a series of half-grabens, with a full graben in the middle, where the widening ocean formed. The Triassic basins (such as the Culpepper Basin) gradually filled with sediments, particularly from the eroding horsts (right). Source: Fichter and Baedke

The Sykesville formed no islands 280 million years ago. In fact, the entire formation lay buried under miles of other rock that is long since gone.

The Alleghanian Orogeny occurred when the proto-African continent slammed into proto-North America, completely closing the ocean that preceded the Atlantic. Proto-Africa rode up over proto-North America, forming a mountain range as high as the Himalayas (fig. 1).

The Alleghanian Mountains covered our area for tens of millions of years. Our part of them drained toward the “west.” (It might have been some other direction, because continental drift over hundreds of millions of years has rotated continents across the points of the compass. For simplicity, though, let’s just call it “west,” as in figure 1.)

So our area drained toward the shallow seas that covered what is now the western United States (fig. 1). At the time, all of the Earth’s continents were joined together in a supercontinent called Pangaea. The Alleghanian Mountains covered the seam between proto-Africa and proto-North America, with our area smack dab in the middle (fig. 1).

After weathering away, the Alleghanian Mountains left an immense plain in the middle of the continent. Like the mountains, the plain tilted to the west. Nothing like the Potomac River yet existed, and the ocean was nowhere nearby (fig. 1).

## Triassic Basins

About 230 million years ago, during the Triassic Period, Pangaea began to break up along the ancient continental suture lines (fig. 2). A magma plume under the super-continent domed our area and thinned the crust. By about 175 million years ago, Africa had broken away from North America, and a widening Atlantic Ocean was forming over the hot spot.

The breakup reactivated old fault lines. To understand those old fault lines, we need to backtrack a bit.

Long before the Alleghanian Orogeny, pieces of oceanic crust collided with proto-North America. Called terranes (labeled Taconic and Acadian in figure 2), they attached themselves to the continental bedrock along suture (or fault) lines. The Taconic Terrane joined itself to the ancient Grenville continental rock, the core of today's Blue Ridge Mountains; in turn, the Avalon (or Acadian) Terrane joined itself to the eastern edge of the Taconic Terrane. Both terranes now underlie the Piedmont and Coastal Plain provinces in our area, and both have dormant thrust faults along the ancient suture lines.

As Africa and North America pulled apart, the faults between the terranes and the continental bedrock became reactivated (fig. 2). As the crust thinned and stretched, great blocks of Taconic Terrane rock (for example) dropped down the fault along the eastern face of the Blue Ridge as if on a hinge, forming enormous escarpments and great rift valleys.

Geologists call the valleys half-grabens (from the German word Graben, meaning pit or grave); and they call the overlooking ridges horsts (from the German word Horst, meaning eyrie). Today's Catoctin Mountain in Maryland and Bull Run Mountain in Virginia, both made up of Blue Ridge rocks, formed great horsts overlooking enormous rift valleys such as the Culpeper Basin (fig. 2), much like the ones in East Africa today along the Great Rift Valley.

The Triassic basins caught runoff from the valley slopes, forming lakes and rivers oriented southwest to northeast (fig. 3). As the land sank

along the horsts, the rivers steadily cut through the hinge zones to the east to flow into the widening sea. Forerunners of the Potomac River thus began in the Triassic basins—the Culpeper Basin in what is now Virginia and the Gettysburg Basin in what is now Maryland.

However, the east-flowing rivers in our area were limited to the area east of the Blue Ridge by the towering escarpments that loomed over the

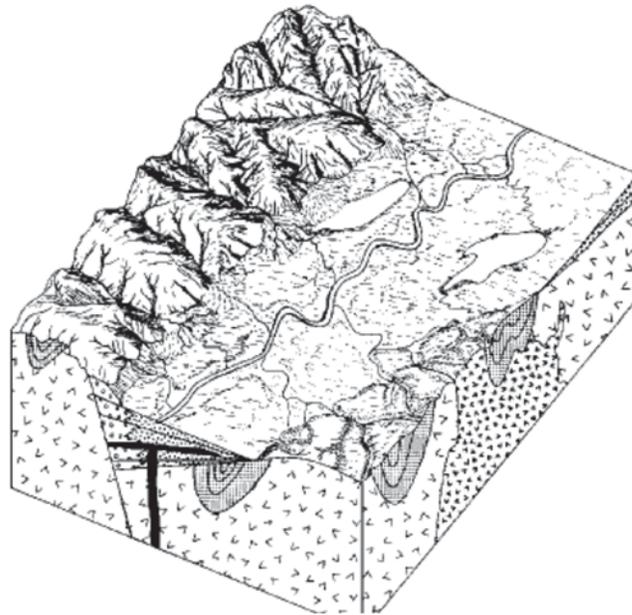


Figure 3—Schematic cross-section of the Culpeper Basin about 200 million years ago. The basin gradually fills with sediments eroded from the horst (left) and carried in by the river that drains the basin. The Vs indicate bedrock; the black bars are a dike and lava flow; the wedges and downfolds are sedimentary rock; the dots on the right indicate igneous plutonic rock. Source: Fichter and Baedke (1999).

Triassic basins. On the plains beyond the escarpments, rivers continued gently meandering to the west, just as they had for millions of years, ever since the Alleghanian Mountains weathered away.

Yet somehow the Potomac River managed to cut through the escarpment. We see the evidence today at Point of Rocks in Maryland, where the Potomac traverses Catoctin Mountain.



## Headward Erosion

The answer lies in a hydrologic process called headward erosion. Streams pouring down from the horsts gradually carved side valleys (fig. 3). To the west of the horst, the slope was gentle, with rivers meandering through plains, much as they do today on East Africa's Serengeti Plain. But to the east, the streams formed rushing torrents that cut down swiftly through the steep rift valley wall, forming deepening canyons.

Eventually, the downcutting east-flowing streams intersected the headwaters of their meandering west-flowing counterparts. Because the eastern channels were deeper, they captured the west-flowing streams, which now flowed toward the east and extended the proto-Potomac River system that was already forming in the Triassic basins.

In the same way, the Potomac River later cut through other Blue Ridge rocks to the west, forming more water gaps, such as the one at Harpers Ferry, WV. By capturing other rivers and streams, the Potomac lengthened its course and multiplied its flows, coming to drain all of northwestern Virginia and beyond. Today, the Potomac has a massive flow, with a watershed reaching through the Blue Ridge and Valley and Ridge provinces into the Allegheny Plateau of West Virginia.

But how did the Potomac River choose its course in a way that cut off a piece of the Sykesville rock in the Piedmont, forming Theodore Roosevelt Island?

## Fractures and Faults

No one knows for sure. As they flow downhill, rivers choose the course of least resistance. That means following faults, folds, and fissures in the rock. But after multiple mountain-building events over more than half a billion years, the metamorphic rock in our area has so many faults, folds, and fissures that it is nearly impossible to tell which way a river flowing over them might turn.

One clue might be the orientation of Theodore Roosevelt Island. The Alleghanian Orogeny placed the ridges and other landforms in our area in roughly parallel positions, ranging from southwest to northeast. The same holds true for the Sykesville and other rock formations in the Piedmont; they, too, range from southwest to northeast.

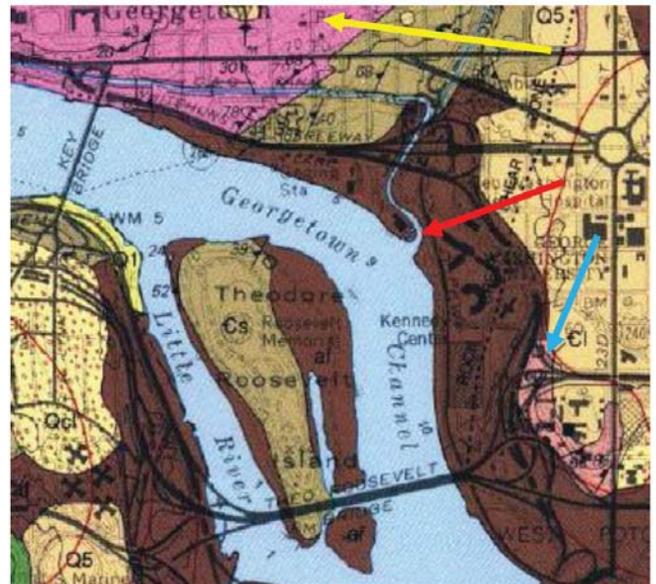


Figure 4—Map detail showing the geology of Theodore Roosevelt Island and areas nearby; Rock Creek is shown by a red arrow. Light brown = Sykesville Formation; light pink = Laurel Formation (blue arrow); dark pink = Georgetown intrusive tonalite (yellow arrow); yellow/tan = Quaternary sediments; dark brown = artificial fill; black = structures. Source: Fleming and others (1994).

By contrast, the orientation of Roosevelt Island is just the opposite (fig. 4). The island forms a low ridge with a narrow plateau of

bedrock running down its spine and the high point at its waist. The orientation is slightly toward the northwest.

The island's orientation suggests that weaker, more fractured, more easily erodible parts of the Sykesville rock lie to the east and west of it, leaving a harder north/south core for the river to flow around.

Interestingly, the Rock Creek Shear Zone lies just to the north in the District of Columbia. The shear zone is a series of faults that affect the course of Rock Creek, which enters the Potomac across from Roosevelt Island (fig. 4, red arrow). Conceivably, such apparent weaknesses in the rock extend to the main Potomac channel at Georgetown, across from Roosevelt Island.

Moreover, figure 4 shows an outcrop of the neighboring Laurel Formation (light pink, blue arrow) across the Georgetown Channel to the east, not far from the Sykesville Formation on Roosevelt Island. Sediments (fig. 4, dark brown) hide the contact zone between the two rock formations, but the fault line might lie directly under the river between the Sykesville and Laurel Formations.

And to the northeast of the Laurel Formation in Georgetown, adjacent to the Sykesville Formation there (fig. 4, light brown), lies a massive igneous intrusion called tonalite (fig. 4, dark pink, yellow arrow). It is directly across the river from the Sykesville Formation in Arlington, VA. Key Bridge connects the two (fig. 4), suggesting another underwater contact zone between disparate rock formations.

So perhaps the Potomac River does follow fault lines at Roosevelt Island between the Sykesville and other rock formations!

## Riverine Sediments

But it hasn't always.

For hundreds of millions of years, rivers have flowed through our area toward the sea, changing course over time. For example, the red sandstone used to build the Smithsonian Castle on the Washington Mall was quarried from a lens of rock formed from sediments left by a river about 200 million years ago in the Triassic basin

near today's Seneca Creek in Maryland. That river is long since gone.

In the early Cretaceous Period (from about 140 million to 100 million years ago), river systems crossing the Fall Line in our area dumped vast quantities of sediments on top of the bedrock, creating a layer of rounded stones and other riverine deposits called the Potomac Formation. In the late Tertiary Period (from about 10 million to 5 million years ago), the pattern resumed, covering the Potomac Formation with similar riverine deposits called



Figure 5—Outcrops of the Sykesville bedrock at the northern end of Theodore Roosevelt Island. Photo: Hutch Brown.

Tertiary Terraces. More recent riverine sediments in the Quaternary Period cover the Tertiary deposits in parts of our area.

In fact, figure 4 shows Quaternary sediments (in yellow and tan) on both sides of the Potomac River. Yet the map shows none on the island itself.

Why not? Are there none?

The Sykesville Formation is well exposed in the northern part of the island (fig. 5), as you might expect from looking at the geologic map. But I have seen no bedrock exposures to the south. On fully two-thirds of the island, including its highest point (where the John Mason house once stood), the bedrock appears to be buried under loads of sediment.

For the nearby Quaternary sediments in Virginia and the District of Columbia, the geologic map describes “gravel, sand, silt, and clay” that are middle Pleistocene to Holocene in age (Fleming and others 1994). On Theodore Roosevelt Island, exposures at the bases of trees and the root balls of toppled trees show just such materials, including rounded river rocks (fig. 6). The materials are almost certainly Quaternary or earlier in origin.



Figure 6—Sediments between tree roots (left) and exposed in the root ball of a toppled tree (right) on Theodore Roosevelt Island. The sediments range in size from cobble to silt; the rounded stones (many of them quartz) are clearly riverine in origin, suggesting that they are Quaternary or older deposits left by the Potomac River or its predecessors, much like those in Arlington, VA. Photos: Hutch Brown.

## A Remarkable Story

The sliver of Sykesville bedrock that forms Theodore Roosevelt Island was once buried beneath some of the world’s highest mountains. Later, it lay beneath some of the world’s broadest plains, drained by rivers flowing to the west, far from the sea.

Today, improbable though it might seem, that sliver of Sykesville bedrock is nearly at sea level, in the middle of a great river flowing generally southeast, the surrounding waters influenced by the tides.

And those lazy tidal waters are full of sediment. Even a casual observer will notice the Potomac River turning brown following a hard rain. Accordingly, the same processes of riverine deposition that have covered the bedrock in our area with sediment below the Fall Line have been

at work on Theodore Roosevelt Island as well (fig. 6).

Yet the island itself shows no mapped sediments—only crystalline bedrock and artificial fill (fig. 4, light brown and dark brown, respectively). Today, the artificial till makes up much of the island, underlying its swamps and marsh.

But it wasn’t always that way. Three hundred years ago, the island had little if any swamp or marsh.

So what about that “artificial fill”? How artificial is it really? Where did it come from and why is it there?

**Next:** The mapped artificial fill that makes up much of Theodore Roosevelt Island today.

## Acknowledgment

The author thanks NVMC member Sue Marcus for reviewing and

improving the article. Any errors are the author’s alone.

## Sources

Blakey, R.C. 2011. Regional paleogeography: Paleogeography and geologic evolution of North America. Northern Arizona University, Flagstaff, AZ.

Callan, B. 2011. Why those curves, Rock Creek? Mountain Beltway. AGU Blogosphere. 27 August.

Fichter, L.S.; Baedke, J.K. 1999. The geological evolution of Virginia and the mid-Atlantic region. Harrisonburg, VA: College of Science and Mathematics, James Madison University.

Fleming, A.H.; Drake, A.A., Jr.; McCartan, L. 1994. Geologic map of the Washington West Quadrangle, District of Columbia, Montgomery and Prince Georges Counties, Maryland, and Arlington and Fairfax Counties, Virginia. Reston, VA: U.S. Geological Survey.

Johnston, P.M. 1964. Geology and ground-water resources of Washington, D.C., and vicinity. Geol. Surv. Water-Supply Pap. 1776. Reston, VA: U.S. Geological Survey.

National Park Service. 2009. Rock Creek Park: Geologic resources inventory report. Nat. Res. Rep. NPS/NRPC/GRD/NRR-2009/146. Denver, CO.

O'Connor, R; Dolinsky, P.D.; Vela, D.; [and others]. 2007. Historic American Landscapes Survey: Theodore Roosevelt Island. HALS no. DC-12. Washington, DC: National Park Service.

## Mineral of the Month – Silver – From Wikipedia and Mindat

**N**ative silver is an uncombined form of silver which occurs as a natural mineral. Silver is a metallic element with symbol Ag and atomic number 47. The symbol Ag stems from Latin argentum, derived from the Greek ἀργός (literally "shiny" or "white"), and ultimately from a Proto-Indo-European language root reconstructed as \*h<sub>2</sub>erǵ-, "grey" or "shining". A soft, white, lustrous transition metal, it exhibits the highest electrical conductivity, thermal conductivity, and reflectivity of any metal. The metal is found in the Earth's crust in the pure, free elemental form ("native silver"), as an alloy with gold and other metals, and in minerals such as argentite and chlorargyrite. Most silver is produced as a byproduct of copper, gold, lead, and zinc refining. Silver is more abundant than gold, but it is much less abundant as a native metal. Its purity is typically measured on a per mille basis; a 94%-pure alloy is described as "0.940 fine".

As one of the seven metals of antiquity, silver has had an enduring role in most human cultures. Silver has long been valued as a precious metal. Silver metal is used in many premodern monetary systems in bullion coins, sometimes alongside gold. Silver is used in numerous applications other than currency, such as solar panels, water filtration, jewelry, ornaments, high-value tableware and utensils (hence the term silverware), and as an investment medium (coins and bullion). Silver is used industrially in electrical contacts and conductors, in specialized mirrors, window coatings, and in catalysis of chemical reactions. Silver compounds are used in

Schruben, P. 1999. Color shaded relief map of the conterminous United States. Open-file rep. 99-11. Reston, VA: U.S. Geological Survey.

USGS (U.S. Geological Survey). 1993. Sykesville Formation. Reston, VA.

Williams, G.P. 1977. Washington D.C.'s vanishing springs and waterways. Geol. Surv. Circ. 752. Reston, VA: U.S. Geological Survey.

photographic film and X-rays. Dilute silver nitrate solutions and other silver compounds are used as disinfectants and microbiocides (oligodynamic effect), added to bandages and wound-dressings, catheters, and other medical instruments.



Native Silver from Kongsberg, Buskerud, Norway. Silver wires. CD Woodhouse collection. #6334 (1974). Scale at bottom of image is an inch with a rule at one cm. Uploaded to Mindat by Rock Currier

Silver is similar in its physical and chemical properties to its two vertical neighbors in group 11 of the periodic table, copper and gold. Its 47 electrons are arranged in the configuration [Kr]4d<sup>10</sup>5s<sup>1</sup>, similarly to copper and gold; group 11 is one of the few groups in the d-block which has a completely consistent set of electron configurations. This distinctive electron configuration, with a single electron in the highest occupied s subshell over a filled d subshell, accounts for many of the singular properties of metallic silver.

Silver is an extremely soft, ductile and malleable transition metal, though it is slightly less malleable than gold. Silver crystallizes in a face-centered cubic lattice with bulk coordination number 12, where only the single 5s electron is delocalized, similarly to

copper and gold. Unlike metals with incomplete d-shells, metallic bonds in silver are lacking a covalent character and are relatively weak. This observation explains the low hardness and high ductility of single crystals of silver.

Silver has a brilliant white metallic luster that can take a high polish, and which is so characteristic that the name of the metal itself has become a colour name. Very high electrical and thermal conductivity is common to the elements in group 11, because their single s electron is free and does not interact with the filled d subshell, as such interactions (which occur in the preceding transition metals) lower electron mobility. The electrical conductivity of silver is the greatest of all metals, greater even than copper, but it is not widely used for this property because of the higher cost. An exception is in radio-frequency engineering, particularly at VHF and higher frequencies where silver plating improves electrical conductivity because those currents tend to flow on the surface of conductors rather than through the interior. Pure silver has the highest thermal conductivity of any metal, although the conductivity of carbon (in the diamond allotrope) and superfluid helium-4 are even higher.

Silver is produced during certain types of supernova explosions by nucleosynthesis from lighter elements through the r-process, a form of nuclear fusion that produces many elements heavier than iron.

Silver is found in native form, as an alloy with gold (electrum), and in ores containing sulfur, arsenic, antimony, or chlorine. Ores include argentite ( $\text{Ag}_2\text{S}$ ), chlorargyrite ( $\text{AgCl}$ , which includes horn silver), and pyrargyrite ( $\text{Ag}_3\text{SbS}_3$ ). The principal sources of silver are the ores of copper, copper-nickel, lead, and lead-zinc obtained from Peru, Bolivia, Mexico, China, Australia, Chile, Poland and Serbia. Peru, Bolivia and Mexico have been mining silver since 1546, and are still major world producers. Top silver-producing mines are Cannington (Australia), Fresnillo (Mexico), San Cristóbal (Bolivia), Antamina (Peru), Rudna (Poland), and Penasquito (Mexico).[93] Top near-term mine development projects through 2015 are Pascua Lama (Chile), Navidad (Argentina), Jaunicipio (Mexico), Malku Khota (Bolivia),[94] and Hackett River (Canada).[93] In Central Asia, Tajikistan is known to have some of the largest silver deposits in the world.

The metal is primarily produced as a byproduct of electrolytic copper refining, gold, nickel, and zinc refining, and by application of the Parkes process on lead bullion from ore that also contains silver. Commercial-grade fine silver is at least 99.9% pure, and purities greater than 99.999% are available. In 2014, Mexico was the top producer of silver (5,000 tons or 18.7% of the world's total of 26,800 t), followed by China (4,060 t) and Peru (3,780 t).



"Halfbreed" copper-silver nugget, Keweenaw County, Michigan, US

Diamond	
Category	Native Minerals
Formula	Ag
Strunz Classification	1/A.01-20
Crystal System	Isometric
Crystal Class	m3m (4/m 3 2/m) - Hexoctahedral
Color	Silver-white, tarnishes dark gray to black
Cleavage	None Observed
Fracture	N
Mohs Scale	2.5-3
Luster	Metallic
Streak	Silver white
Specific Gravity	10.1-11.1
Melting Point	1984.32 F

## Geologist of the Month – James Hutton – from Wikipedia



James Hutton (3 June 1726 – 26 March 1797) was a Scottish geologist, physician, chemical manufacturer, naturalist, and experimental agriculturalist. He originated the theory of uniformitarianism—a fundamental principle of geology—which explains the features of the Earth's crust by means of natural processes over geologic time. Hutton's work established geology as a proper science, and thus he is often referred to as the "Father of Modern Geology".

Through observation and carefully reasoned geological arguments, Hutton came to believe that the Earth was perpetually being formed; he recognised that the history of the Earth could be determined by understanding how processes such as erosion and sedimentation work in the present day. His theories of geology and geologic time, also called deep time, came to be included in theories which were called plutonism and uniformitarianism. Some of his writings anticipated the Gaia hypothesis.

Hutton was born in Edinburgh on 3 June 1726 as one of five children of William Hutton, a

merchant who was Edinburgh City Treasurer, and his wife, Sarah Balfour. His father died in 1729, when James was only three.

He was educated at the High School of Edinburgh (as were most Edinburgh children) where he was particularly interested in mathematics and chemistry, then when he was 14 he attended the University of Edinburgh as a "student of humanity", i.e., Classics (Latin and Greek). He was apprenticed to the lawyer George Chalmers WS when he was 17, but took more interest in chemical experiments than legal work. At the age of 18, he became a physician's assistant, and attended lectures in medicine at the University of Edinburgh. After three years he went to the University of Paris to continue his studies, taking the degree of Doctor of Medicine at Leiden University in 1749 with a thesis on blood circulation. Around 1747 he had a son by a Miss Edington, and though he gave his child James Smeaton Hutton financial assistance, he had little to do with the boy who went on to become a post-office clerk in London.

After his degree Hutton returned to London, then in mid-1750 went back to Edinburgh and resumed chemical experiments with close friend, James Davie. Their work on production of sal ammoniac from soot led to their partnership in a profitable chemical works, manufacturing the crystalline salt which was used for dyeing, metalworking and as smelling salts and had been available only from natural sources and had to be imported from Egypt. Hutton owned and rented out properties in Edinburgh, employing a factor to manage this business.

Hutton inherited from his father the Berwickshire farms of Slighhouses, a lowland farm which had been in the family since 1713, and the hill farm of Nether Monynut. In the early 1750s he moved to Slighhouses and set about making improvements, introducing farming practices from other parts of Britain and experimenting with plant and animal husbandry. He recorded his ideas and innovations in an unpublished treatise on "The Elements of Agriculture".

This developed his interest in meteorology and geology. In a 1753 letter he wrote that he had "become very fond of studying the surface of the earth, and was looking with anxious curiosity into every pit or ditch or bed of a river that fell in his way". Clearing and draining his farm provided ample opportunities. Playfair describes Hutton as having noticed that "a vast proportion of the present rocks are composed of materials afforded by the destruction of bodies, animal, vegetable and mineral, of more ancient formation". His theoretical ideas began to come together in 1760. While his farming activities continued, in 1764 he went on a geological tour of the north of Scotland with George Maxwell-Clerk, ancestor of the famous James Clerk Maxwell.

In 1768 Hutton returned to Edinburgh, letting his farms to tenants but continuing to take an interest in farm improvements and research which included experiments carried out at Slighouses. He developed a red dye made from the roots of the madder plant.

He had a house built in 1770 at St John's Hill, Edinburgh, overlooking Salisbury Crags. This later became the Balfour family home and, in 1840, the birthplace of the psychiatrist James Crichton-Browne. Hutton was one of the most influential participants in the Scottish Enlightenment, and fell in with numerous first-class minds in the sciences including John Playfair, philosopher David Hume and economist Adam Smith. Hutton held no position in Edinburgh University and communicated his scientific findings through the Royal Society of Edinburgh. He was particularly friendly with Joseph Black, and the two of them together with Adam Smith founded the Oyster Club for weekly meetings.

Between 1767 and 1774 Hutton had close involvement with the construction of the Forth and Clyde canal, making full use of his geological knowledge, both as a shareholder and as a member of the committee of management, and attended meetings including extended site inspections of all the works. At this time he is listed as living on Bernard Street in Leith. In 1777

he published a pamphlet on Considerations on the Nature, Quality and Distinctions of Coal and Culm which successfully helped to obtain relief from excise duty on carrying small coal.

In 1783 he was a joint founder of the Royal Society of Edinburgh.

From 1791 Hutton suffered extreme pain from stones in the bladder and gave up field work to concentrate on finishing his books. A dangerous (and painful) operation failed to resolve his illness.

He died in Edinburgh and was buried in the vault of Andrew Balfour, opposite the vault of his friend Joseph Black, in the now sealed south-west section of Greyfriars Kirkyard commonly known as the Covenanter's Prison. He did not marry and had no children.

Hutton hit on a variety of ideas to explain the rock formations he saw around him, but according to Playfair he "was in no haste to publish his theory; for he was one of those who are much more delighted with the contemplation of truth, than with the praise of having discovered it". After some 25 years of work, his "Theory of the Earth; or an Investigation of the Laws observable in the Composition, Dissolution, and Restoration of Land upon the Globe" was read to meetings of the Royal Society of Edinburgh in two parts, the first by his friend Joseph Black on 7 March 1785, and the second by himself on 4 April 1785. Hutton subsequently read an abstract of his dissertation "Concerning the System of the Earth, its Duration and Stability" to Society meeting on 4 July 1785, which he had printed and circulated privately. In it, he outlined his theory as follows;

The solid parts of the present land appear in general, to have been composed of the productions of the sea, and of other materials similar to those now found upon the shores. Hence we find reason to conclude:

First, that the land on which we rest is not simple and original, but that it is a composition, and had been formed by the operation of second causes; and second, that before the present land was made, there had subsisted a world composed

of sea and land, in which were tides and currents, with such operations at the bottom of the sea as now take place. And, lastly, that while the present land was forming at the bottom of the ocean, the former land maintained plants and animals; at least the sea was then inhabited by animals, in a similar manner as it is at present.

Hence we are led to conclude, that the greater part of our land, if not the whole had been produced by operations natural to this globe; but that in order to make this land a permanent body, resisting the operations of the waters, two things had been required:

First, the consolidation of masses formed by collections of loose or incoherent materials; Secondly, the elevation of those consolidated masses from the bottom of the sea, the place where they were collected, to the stations in which they now remain above the level of the ocean.

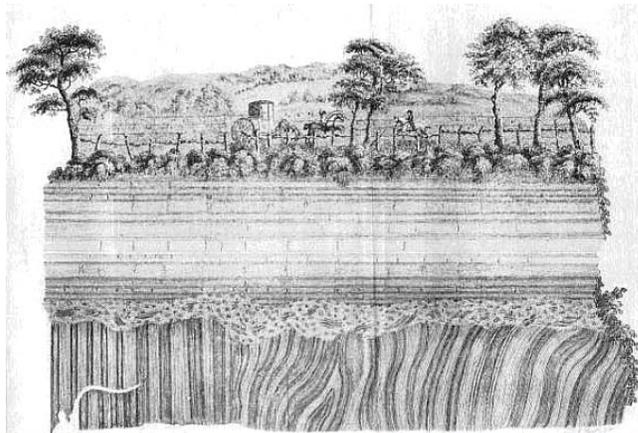
At Glen Tilt in the Cairngorm Mountains in the Scottish Highlands in 1785, Hutton found granite penetrating metamorphic schists, in a way which indicated that the granite had been molten at the time. This showed to him that granite formed from cooling of molten rock, not precipitation out of water as others at the time believed, and that the granite must be younger than the schists.

He went on to find a similar penetration of volcanic rock through sedimentary rock near the center of Edinburgh, at Salisbury Crags, adjoining Arthur's Seat: this is now known as Hutton's Section. He found other examples in Galloway in 1786, and on the Isle of Arran in 1787.

The existence of angular unconformities had been noted by Nicolas Steno and by French geologists including Horace-Bénédict de Saussure, who interpreted them in terms of Neptunism as "primary formations". Hutton wanted to examine such formations himself to see "particular marks" of the relationship between the rock layers. On the 1787 trip to the Isle of Arran he found his first example of Hutton's Unconformity to the north of Newton Point near Lochranza, but the limited view meant that the condition of the

underlying strata was not clear enough for him, and he incorrectly thought that the strata were conformable at a depth below the exposed outcrop.

Later in 1787 Hutton noted what is now



known as the Hutton or "Great" Unconformity at Inchbonny, Jedburgh, in layers of sedimentary rock. As shown in the illustration, layers of greywacke in the lower layers of the cliff face are tilted almost vertically, and above an intervening layer of conglomerate lie horizontal layers of Old Red Sandstone. He later wrote of how he "rejoiced at my good fortune in stumbling upon an object so interesting in the natural history of the earth, and which I had been long looking for in vain." That year, he found the same sequence in Teviotdale.

An eroded outcrop at Siccar Point showing sloping red sandstone above vertical greywacke was sketched by Sir James Hall in 1788.

In the spring of 1788 he set off with John Playfair to the Berwickshire coast and found more examples of this sequence in the valleys of the Tour and Pease Burns near Cockburnspath. They then took a boat trip from Dunglass Burn east along the coast with the geologist Sir James Hall of Dunglass. They found the sequence in the cliff below St. Helens, then just to the east at Siccar Point found what Hutton called "a beautiful picture of this junction washed bare by the sea". Playfair later commented about the experience, "the mind seemed to grow giddy by looking so far into the abyss of time". Continuing along the coast, they made more discoveries including sections of the vertical beds showing strong ripple marks which gave Hutton "great satisfaction" as a confirmation of his supposition

that these beds had been laid horizontally in water. He also found conglomerate at altitudes that demonstrated the extent of erosion of the strata, and said of this that "we never should have dreamed of meeting with what we now perceived".

Hutton reasoned that there must have been innumerable cycles, each involving deposition on the seabed, uplift with tilting and erosion then undersea again for further layers to be deposited. On the belief that this was due to the same geological forces operating in the past as the very slow geological forces seen operating at the present day, the thicknesses of exposed rock layers implied to him enormous stretches of time.

## Mineralogical Society of America Editors' Picks

With the permission of Keith Putirka, the following are the Editor's picks of Highlights and Breakthroughs & Invited Centennial Articles from the December 2016 and January 2017 issues of the *American Mineralogist: Journal of Earth and Planetary Materials*. <http://www.minsocam.org>

### A Rover with a View (to the Early Martian Surface)

On page 233 of this issue Joshua Bandfield provides a perspective on the new mineralogical study by Ruff and Hamilton et al. (p. 235 of this volume) on the pre-3.7 Ga Columbian Hills. Their study compares the mineralogy of two ancient surfaces, one more greatly affected by hydrous weathering than the other. They find that Martian weathering, at least in this one region, involved little cation removal, and so little in the way of quartz or phyllosilicates, or the production of amorphous Si phases such as opal. As Bandfield notes, the attention drawn to Martian phyllosilicates and various hydrous amorphous Si phases is out of proportion to their scarcity on the Martian surface. Instead, the style of weather implied by the mineralogical study of Ruff and Hamilton, is one quite foreign to Earth where even in its coldest, driest parts, phyllosilicates and amorphous Si phases are common. On Mars, then, despite the evidence

for aqueous erosion, the dominant weathering theme may be one of "acid fog", however apparently contradictory these erosion and weathering themes may be.

### Special Collection: Geology and Geobiology of Lassen National Park. Mantle or Crust Explains high d18O?

On page 252 of this issue, Underwood and Clyne present new d18O data on Ol, Cpx, and Plag grains derived from mafic lavas of the Lassen Volcanic Center of the southern Cascades. Their investigation plays into the larger question of whether elevated d18O in whole rocks indicates contamination of such by a crustal source, or partial melting of a heterogeneous mantle. They find that d18O is uncorrelated to radiogenic isotopic ratios (Sr, Nd, and Hf) as well as trace element proxies for subducted fluid inputs (Sr/P), but isotopic ratios allow that the range of observed d18O may be mantle derived. Clearly the next step is to compare d18O in olivine to

forsterite contents, which should provide a near-decisive test of whether high  $d18O$  ratios reflect high-T mantle or low-T crustal processes.

### **Special Collection: Dynamics of Magmatic Processes. Phenocrysts and Groundmass Age Dates Delimit Magma Storage Times**

On page 262 of this issue Casalini et al. present new isotopic and additional geochemical data on the Ischia Volcano of southern Italy. Most fascinating is their Figure 10, where they find different  $87Sr/86Sr$  ratios for groundmass and phenocryst phases, which based on analyzed  $Rb/Sr$  ratios permit to calculate crystallization intervals, which is obtained when groundmass and phenocrysts are nominally in isotopic equilibrium. The mineral residence times are then inferred from K-Ar-derived eruption ages. Their method yields time scales of magma storage and crystallization that range from tens to hundreds of thousands of years, with the most evolved magmas being stored in isolated pockets at cool temperatures, of ca. 750 °C. These time scale estimates at Ischia provide the first radiogenic isotope probe of the novel approach of Cashman and Giordano (2014).

### **Special Collection: Water in Nominally Anhydrous Minerals. How OH<sup>-</sup> is incorporated into Olivine**

On page 302 of this issue, Blanchard et al. re-examine the nature of “water solubility in olivine (as OH<sup>-</sup>). Through a range of spectroscopic and computational methods the authors show that OH<sup>-</sup> solubility is controlled less by total Fe contents than by the total amounts of tri- and tetra-valent cations. Their work indicates that prior studies of OH<sup>-</sup> solubility can be re-interpreted so as to indicate that defect sites populated by OH<sup>-</sup> are associated with Ti<sup>4+</sup> and Fe<sup>3+</sup> in particular, and that H is dissolved mostly as a hydrogarnet species, where 4H occupy a tetrahedral vacancy and only more rarely as 2H occupying an octahedral vacancy.

### **CaSiO<sub>3</sub>-Perovskite: The Engine that Powers Mantle Convection**

On page 321 of this issue Perry et al. use ab initio calculations to investigate the solubility of Th, and U into CaSiO<sub>3</sub>-perovskite with and without Al. They find that enthalpies of solution favor the dissolution of Th<sup>4+</sup>, and especially U<sup>4+</sup>, as coupled substitutions with Al<sup>3+</sup>. Their work suggests that subducting slabs may provide a key mechanism for transporting heat producing elements into the deep mantle. Subducting slabs host Ca-Al rich minerals that promote the storage and transport of U and Th leading to the formation of Al-bearing CaSiO<sub>3</sub>-perovskite as slabs penetrate the lower mantle. The authors also suggest that their findings may help the recipes for synroc compositions so as to optimize their chemistry for U and Th dissolution into perovskite-like structures.

### **Near-surface kerogen in deep-seated diamonds?**

On page 391 of this issue, Childress and Jacobsen investigate the stability of kerogen at simultaneously high P and moderate T conditions. They find that increases in pressure allow an increase in the thermal stability of kerogen such that the coolest portions of subducted slabs can provide a pathway for carbon into the mantle. Their work provides a possible mechanism to explain recent findings of apparently organic carbon in some deep-seated diamonds.

### **Igneous or metamorphic hornblende?**

On page 436 of this issue, Challener and Glazner, in a stunningly colorful contribution (pictorially, not in prose), examine hornblende compositions from the Half Dome Granodiorite of Yosemite National Park, California. Some of the crystals they examine are quite large, ranging to 2 cm in length, and are euhedral and unaltered in appearance. And yet, these authors suggest that these crystals record mostly a metamorphic history, rather than igneous one. In their interpretation, igneous crystals of the same size and shape were metamorphosed to greenschist facies conditions. Their evidence includes the bulk Hbl compositions, which are equivalent to hornblende “plus a small

proportion of biotite”. They suggest that the original, igneous Hbl reacted with biotite inclusions, and perhaps quartz (rare as an inclusion, presumably due to reaction), to produce magnetite, alkali feldspars and clinozoisite, which are common as inclusions. Their interpretation is supported by exsolution textures indicative of low temperature equilibration.

### P-T Conditions at the White Sands Nuclear Detonation Site

On page 445 of this issue, Lussier et al. examine the glassy arkosic sandstone called “Trinitite”, a synthetic product of 16 July 1945 nuclear test at the White Sands Proving Grounds

in New Mexico. As noted by the authors, Trinitite has mostly been studied as a curiosity, but renewed interest involves its use as a test case for future forensic studies that may be needed to uncover bomb design, fuel material, etc., and trace these to a user of such. They find that quartz and zircon are both reliable recorders of blast P-T conditions and that nanoscale analyses of zircon grain (featuring remarkably dendritic rims — well worth a look at their Fig. 1) record the changing P-T-t conditions as a blast evolves. In this particular case, the authors infer T of >1500 C and P <10 GPa, the latter being quite below that of a meteorite impact.

### Useful Mineral Links:



Eastern Federation of Mineralogical and Lapidary Societies (EFMLS)

[www.amfed.org/efmls](http://www.amfed.org/efmls)



American Federation of Mineralogical Societies (AFMS)

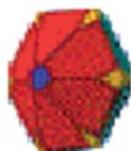
[www.amfed.org](http://www.amfed.org)



[mindat.org](http://mindat.org)

MINDAT

[www.mindat.org](http://www.mindat.org)



WebMineral

[webmineral.com](http://webmineral.com)



Mineralogical Society of America

[www.minsocam.org](http://www.minsocam.org)



The Geological Society of America (GSA)

[www.geosociety.org](http://www.geosociety.org)

## Upcoming Local (or mostly local) Geology Events:

### March:

- 1 MSDC March Meeting
- 4-5 Wilmington, DE – 54th Annual Gem, Mineral & Fossil Show
- 18-19 GLMSC Spring Show, Montgomery County Fairgrounds

Adult Admission \$6 each  
Group with this Ad. All \$5 each  
11 and under Free!



**March 18-19, 2017**  
Sat. 10 am-6 pm  
Sun. 11 am-5 pm

The Gem, Lapidary, and Mineral Society of Montgomery County, MD.

#### Featuring:

- |                      |                              |                  |
|----------------------|------------------------------|------------------|
| Door prizes          | Free specimens for the kids! | Over 40 exhibits |
| Demonstrations       | DIY cabachon making          | Raffle           |
| Fluorescent minerals | Free kid's mini mine         |                  |

More than 20 dealers from around the country featuring:

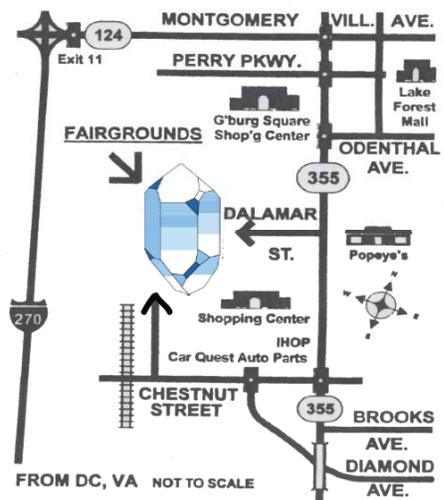
- |               |                  |            |
|---------------|------------------|------------|
| Fossils       | Jewelry          | Beads      |
| Minerals      | Fluorescents     | Meteorites |
| New age items | Gems & gem rough | And more   |

[www.glmsmc.com](http://www.glmsmc.com)

© 2017

#### Montgomery County Fairgrounds

GPS: 39°8'44"N  
77°12'22"W  
Building 6  
16 Chestnut Street  
Gaithersburg  
Maryland



31 Mar – 1 Apr Atlantic Micromounters' Conference, SpringHill Suites by Marriott in Alexandria, VA. Sponsored by the Micromineralogists of the National Capital Area, Inc.

### April:

- 1-2 Midland Park, NJ – 28th Annual North Jersey Gem, Mineral & Fossil Show
- 5 MSDC April Meeting
- 7-9 Edison, NJ - The Annual NY-NJ Mineral, Fossil, Gem & Jewelry Show <http://www.ny-nj-gemshow.com/index.php>
- 29 Sterling Hill Super Dig
- 29-30 Annual Spring Franklin Gem & Mineral Show & Swap, Franklin Elementary School, Washington Ave. Franklin, NJ – and they are making arrangements to access previously closed portions of the Buckwheat Dump – but you have to register early.
- 29-30 Ogdensburg, NJ – Annual Sterling Hill Garage Sale
- 29-30 Franklin, NJ - Annual NJ Earth Science Association Show at the Washington School

**May:**

- 3 MSDC May Meeting
- ? Ogdensburg, NJ – NoJMS Spring Swap & Sale at Sterling Hill Mining Museum

**June**

- 3 Spring Mineralfest - Macungie, Pennsylvania - 68th semi-annual Mineralfest
- 7 MSDC June Meeting

## 44th Annual Atlantic Micromounters' Conference



**March 31 - April 1, 2017**

**SpringHill Suites by Marriott  
Alexandria, VA**



Presented by

**The Micromineralogists of the National Capital Area, Inc.  
50th Anniversary MNCA 1967 - 2017**

**Friday March 31, 6-9pm Saturday April 1, 8:30am – 9pm**

**We invite you to attend our annual conference.**

**Featured speaker: Dr. Michael A. Wise, Geologist, Department of Mineral Sciences at the Smithsonian's National Museum of Natural History**

Dr. Michael Wise has been studying pegmatites all over the world for the past 30 years. His research focuses on the chemistry of rare minerals to understand how pegmatites form and evolve. These same rare minerals can also be used to help locate potential new deposits of economic significance. Mike's research has included studies of pegmatites in the New England states, California, Colorado, Nevada, North Carolina, and Virginia. He also visited sites with pegmatites in Brazil, Canada, the Czech Republic, Italy, Madagascar, and Namibia. Mike is heavily involved in managing the Smithsonian's Gem and Mineral Collections. He is also very active in the museum's education and outreach. He received his Ph.D. at the University of Manitoba in 1987. Dr. Wise will give two talks on his research, and one on the Smithsonian Micromount Collection.

Saturday 7pm: Scott Duresky will present "Newly-Identified Members of the Microlite Group from the Historic Rutherford Mine Pegmatite at Amelia Courthouse, Virginia".

50<sup>th</sup> Golden Anniversary – Honoring Paul & Jennie Smith, Fred Schaefermeyer, Joe Murter, Eric Grundel, George Reimherr, and our charter member, Cynthia Payne.

Registration fee \$30. Includes 4 Lectures: Friday evening coffee/tea social with light appetizers. Saturday continental breakfast, and lunch are included - deli sandwiches, side dishes, beverages, and dessert. Mineral dealers, silent auction, micromineral auction, mineral giveaways, geology friendship. Make checks payable to: Atlantic Micromounters' Conference

Mail payment to: Kathy Hrechka 7201 Ludwood Court, Alexandria, VA 22306

Club website [www.dcmicrominerals.org](http://www.dcmicrominerals.org)

## Atlantic Micromounters' Conference Mar 31 – Apr 1, 2017

### Registration form

Club website [www.dcmicrominerals.org](http://www.dcmicrominerals.org)

Please complete the form below and mail it before March 24.

Make checks payable to: Atlantic Micromounters' Conference

Return registration to: Kathy Hrechka

7201 Ludwood Court

Alexandria, VA 22306

\*SpringHill Suites by Marriott; 6065 Richmond Highway, Alexandria, VA 22303

\$129 USD Studio 2 Queen & Sofa bed Check in: 3/31/17 Check out: 4/2/17

Hotel reservation Group code: AMC Cut- off date: 3/10/17 Phone: (571) 481-4441

Book your hotel group rate: [Book your group rate for Atlantic Micromounters](#)

\*Holiday Inn Express; 6055 Richmond Hwy, Alexandria, VA 22303

Phone:(571) 257-9555 (Next door to conference site)

\*Days Inn Alexandria South, 6100 Richmond Hwy., Alexandria, VA 22303

Phone: (703) 329-0500 (Across street from conference site)

\*Red Roof Inn; 5975 Richmond Hwy 5975 Richmond Hwy., Alexandria, VA 22303

Phone: (703) 960-5200 (1/8-mile North of conference site)

----- \_cut here

Please print all information and return this portion to Kathy, along with your payment. 2017

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Telephone \_\_\_\_\_ Email \_\_\_\_\_

Pre-Registration \$30. (before March 24) Number \_\_\_\_\_ Total \$ \_\_\_\_\_

Registration at the door will be \$35.

Check the portions of the conference you will be attending.

Friday Reception 6-9pm \_\_\_\_\_ Saturday Conference 8:30am-9pm \_\_\_\_\_

For future conference planning, where are you staying?

Hotel name? \_\_\_\_\_ Home \_\_\_\_\_

# The Periodic Table of Elements

**ALKALI METALS**

**1** Hydrogen (1.00794)  
**2** Lithium (6.941)  
**3** Sodium (22.98976928)  
**4** Potassium (39.0983)  
**5** Rubidium (85.4678)  
**6** Cesium (132.90545196)  
**7** Francium (223)

**ALKALI METALS**

**8** Beryllium (9.012182)  
**9** Magnesium (24.304)  
**10** Calcium (40.078)  
**11** Strontium (87.62)  
**12** Barium (137.327)  
**13** Radium (226)

**TRANSITION METALS**

**14** Vanadium (50.9415)  
**15** Chromium (51.99616)  
**16** Manganese (54.938045)  
**17** Iron (55.845)  
**18** Cobalt (58.933195)  
**19** Nickel (58.6934)  
**20** Copper (63.546)  
**21** Zinc (65.38)  
**22** Gallium (69.723)  
**23** Germanium (72.63)  
**24** Arsenic (74.921595)  
**25** Selenium (78.96)  
**26** Bromine (79.904)  
**27** Krypton (83.80)  
**28** Rubidium (85.4678)  
**29** Strontium (87.62)  
**30** Yttrium (88.905848)  
**31** Zirconium (91.224)  
**32** Niobium (92.90638)  
**33** Molybdenum (95.94)  
**34** Technetium (98)  
**35** Ruthenium (101.07)  
**36** Rhodium (102.90550)  
**37** Palladium (106.3676)  
**38** Silver (107.8682)  
**39** Cadmium (112.411)  
**40** Indium (114.818)  
**41** Tin (118.710)  
**42** Antimony (121.757)  
**43** Tellurium (127.603)  
**44** Iodine (126.90447)  
**45** Xenon (131.29)  
**46** Barium (137.327)  
**47** Radium (226)  
**48** Actinium (227)

**TRANSITION METALS**

**49** Vanadium (50.9415)  
**50** Chromium (51.99616)  
**51** Manganese (54.938045)  
**52** Iron (55.845)  
**53** Cobalt (58.933195)  
**54** Nickel (58.6934)  
**55** Copper (63.546)  
**56** Zinc (65.38)  
**57** Gallium (69.723)  
**58** Germanium (72.63)  
**59** Arsenic (74.921595)  
**60** Selenium (78.96)  
**61** Bromine (79.904)  
**62** Krypton (83.80)  
**63** Rubidium (85.4678)  
**64** Strontium (87.62)  
**65** Yttrium (88.905848)  
**66** Zirconium (91.224)  
**67** Niobium (92.90638)  
**68** Molybdenum (95.94)  
**69** Technetium (98)  
**70** Ruthenium (101.07)  
**71** Rhodium (102.90550)  
**72** Palladium (106.3676)  
**73** Silver (107.8682)  
**74** Cadmium (112.411)  
**75** Indium (114.818)  
**76** Tin (118.710)  
**77** Antimony (121.757)  
**78** Tellurium (127.603)  
**79** Iodine (126.90447)  
**80** Xenon (131.29)  
**81** Barium (137.327)  
**82** Radium (226)  
**83** Actinium (227)

**TRANSITION METALS**

**84** Vanadium (50.9415)  
**85** Chromium (51.99616)  
**86** Manganese (54.938045)  
**87** Iron (55.845)  
**88** Cobalt (58.933195)  
**89** Nickel (58.6934)  
**90** Copper (63.546)  
**91** Zinc (65.38)  
**92** Gallium (69.723)  
**93** Germanium (72.63)  
**94** Arsenic (74.921595)  
**95** Selenium (78.96)  
**96** Bromine (79.904)  
**97** Krypton (83.80)  
**98** Rubidium (85.4678)  
**99** Strontium (87.62)  
**100** Yttrium (88.905848)  
**101** Zirconium (91.224)  
**102** Niobium (92.90638)  
**103** Molybdenum (95.94)  
**104** Technetium (98)  
**105** Ruthenium (101.07)  
**106** Rhodium (102.90550)  
**107** Palladium (106.3676)  
**108** Silver (107.8682)  
**109** Cadmium (112.411)  
**110** Indium (114.818)  
**111** Tin (118.710)  
**112** Antimony (121.757)  
**113** Tellurium (127.603)  
**114** Iodine (126.90447)  
**115** Xenon (131.29)  
**116** Barium (137.327)  
**117** Radium (226)  
**118** Actinium (227)

**TRANSITION METALS**

**119** Vanadium (50.9415)  
**120** Chromium (51.99616)  
**121** Manganese (54.938045)  
**122** Iron (55.845)  
**123** Cobalt (58.933195)  
**124** Nickel (58.6934)  
**125** Copper (63.546)  
**126** Zinc (65.38)  
**127** Gallium (69.723)  
**128** Germanium (72.63)  
**129** Arsenic (74.921595)  
**130** Selenium (78.96)  
**131** Bromine (79.904)  
**132** Krypton (83.80)  
**133** Rubidium (85.4678)  
**134** Strontium (87.62)  
**135** Yttrium (88.905848)  
**136** Zirconium (91.224)  
**137** Niobium (92.90638)  
**138** Molybdenum (95.94)  
**139** Technetium (98)  
**140** Ruthenium (101.07)  
**141** Rhodium (102.90550)  
**142** Palladium (106.3676)  
**143** Silver (107.8682)  
**144** Cadmium (112.411)  
**145** Indium (114.818)  
**146** Tin (118.710)  
**147** Antimony (121.757)  
**148** Tellurium (127.603)  
**149** Iodine (126.90447)  
**150** Xenon (131.29)  
**151** Barium (137.327)  
**152** Radium (226)  
**153** Actinium (227)

**TRANSITION METALS**

**154** Vanadium (50.9415)  
**155** Chromium (51.99616)  
**156** Manganese (54.938045)  
**157** Iron (55.845)  
**158** Cobalt (58.933195)  
**159** Nickel (58.6934)  
**160** Copper (63.546)  
**161** Zinc (65.38)  
**162** Gallium (69.723)  
**163** Germanium (72.63)  
**164** Arsenic (74.921595)  
**165** Selenium (78.96)  
**166** Bromine (79.904)  
**167** Krypton (83.80)  
**168** Rubidium (85.4678)  
**169** Strontium (87.62)  
**170** Yttrium (88.905848)  
**171** Zirconium (91.224)  
**172** Niobium (92.90638)  
**173** Molybdenum (95.94)  
**174** Technetium (98)  
**175** Ruthenium (101.07)  
**176** Rhodium (102.90550)  
**177** Palladium (106.3676)  
**178** Silver (107.8682)  
**179** Cadmium (112.411)  
**180** Indium (114.818)  
**181** Tin (118.710)  
**182** Antimony (121.757)  
**183** Tellurium (127.603)  
**184** Iodine (126.90447)  
**185** Xenon (131.29)  
**186** Barium (137.327)  
**187** Radium (226)  
**188** Actinium (227)

**TRANSITION METALS**

**189** Vanadium (50.9415)  
**190** Chromium (51.99616)  
**191** Manganese (54.938045)  
**192** Iron (55.845)  
**193** Cobalt (58.933195)  
**194** Nickel (58.6934)  
**195** Copper (63.546)  
**196** Zinc (65.38)  
**197** Gallium (69.723)  
**198** Germanium (72.63)  
**199** Arsenic (74.921595)  
**200** Selenium (78.96)  
**201** Bromine (79.904)  
**202** Krypton (83.80)  
**203** Rubidium (85.4678)  
**204** Strontium (87.62)  
**205** Yttrium (88.905848)  
**206** Zirconium (91.224)  
**207** Niobium (92.90638)  
**208** Molybdenum (95.94)  
**209** Technetium (98)  
**210** Ruthenium (101.07)  
**211** Rhodium (102.90550)  
**212** Palladium (106.3676)  
**213** Silver (107.8682)  
**214** Cadmium (112.411)  
**215** Indium (114.818)  
**216** Tin (118.710)  
**217** Antimony (121.757)  
**218** Tellurium (127.603)  
**219** Iodine (126.90447)  
**220** Xenon (131.29)  
**221** Barium (137.327)  
**222** Radium (226)  
**223** Actinium (227)

**TRANSITION METALS**

**224** Vanadium (50.9415)  
**225** Chromium (51.99616)  
**226** Manganese (54.938045)  
**227** Iron (55.845)  
**228** Cobalt (58.933195)  
**229** Nickel (58.6934)  
**230** Copper (63.546)  
**231** Zinc (65.38)  
**232** Gallium (69.723)  
**233** Germanium (72.63)  
**234** Arsenic (74.921595)  
**235** Selenium (78.96)  
**236** Bromine (79.904)  
**237** Krypton (83.80)  
**238** Rubidium (85.4678)  
**239** Strontium (87.62)  
**240** Yttrium (88.905848)  
**241** Zirconium (91.224)  
**242** Niobium (92.90638)  
**243** Molybdenum (95.94)  
**244** Technetium (98)  
**245** Ruthenium (101.07)  
**246** Rhodium (102.90550)  
**247** Palladium (106.3676)  
**248** Silver (107.8682)  
**249** Cadmium (112.411)  
**250** Indium (114.818)  
**251** Tin (118.710)  
**252** Antimony (121.757)  
**253** Tellurium (127.603)  
**254** Iodine (126.90447)  
**255** Xenon (131.29)  
**256** Barium (137.327)  
**257** Radium (226)  
**258** Actinium (227)

**TRANSITION METALS**

**259** Vanadium (50.9415)  
**260** Chromium (51.99616)  
**261** Manganese (54.938045)  
**262** Iron (55.845)  
**263** Cobalt (58.933195)  
**264** Nickel (58.6934)  
**265** Copper (63.546)  
**266** Zinc (65.38)  
**267** Gallium (69.723)  
**268** Germanium (72.63)  
**269** Arsenic (74.921595)  
**270** Selenium (78.96)  
**271** Bromine (79.904)  
**272** Krypton (83.80)  
**273** Rubidium (85.4678)  
**274** Strontium (87.62)  
**275** Yttrium (88.905848)  
**276** Zirconium (91.224)  
**277** Niobium (92.90638)  
**278** Molybdenum (95.94)  
**279** Technetium (98)  
**280** Ruthenium (101.07)  
**281** Rhodium (102.90550)  
**282** Palladium (106.3676)  
**283** Silver (107.8682)  
**284** Cadmium (112.411)  
**285** Indium (114.818)  
**286** Tin (118.710)  
**287** Antimony (121.757)  
**288** Tellurium (127.603)  
**289** Iodine (126.90447)  
**290** Xenon (131.29)  
**291** Barium (137.327)  
**292** Radium (226)  
**293** Actinium (227)

**TRANSITION METALS**

**294** Vanadium (50.9415)  
**295** Chromium (51.99616)  
**296** Manganese (54.938045)  
**297** Iron (55.845)  
**298** Cobalt (58.933195)  
**299** Nickel (58.6934)  
**300** Copper (63.546)  
**301** Zinc (65.38)  
**302** Gallium (69.723)  
**303** Germanium (72.63)  
**304** Arsenic (74.921595)  
**305** Selenium (78.96)  
**306** Bromine (79.904)  
**307** Krypton (83.80)  
**308** Rubidium (85.4678)  
**309** Strontium (87.62)  
**310** Yttrium (88.905848)  
**311** Zirconium (91.224)  
**312** Niobium (92.90638)  
**313** Molybdenum (95.94)  
**314** Technetium (98)  
**315** Ruthenium (101.07)  
**316** Rhodium (102.90550)  
**317** Palladium (106.3676)  
**318** Silver (107.8682)  
**319** Cadmium (112.411)  
**320** Indium (114.818)  
**321** Tin (118.710)  
**322** Antimony (121.757)  
**323** Tellurium (127.603)  
**324** Iodine (126.90447)  
**325** Xenon (131.29)  
**326** Barium (137.327)  
**327** Radium (226)  
**328** Actinium (227)

**TRANSITION METALS**

**329** Vanadium (50.9415)  
**330** Chromium (51.99616)  
**331** Manganese (54.938045)  
**332** Iron (55.845)  
**333** Cobalt (58.933195)  
**334** Nickel (58.6934)  
**335** Copper (63.546)  
**336** Zinc (65.38)  
**337** Gallium (69.723)  
**338** Germanium (72.63)  
**339** Arsenic (74.921595)  
**340** Selenium (78.96)  
**341** Bromine (79.904)  
**342** Krypton (83.80)  
**343** Rubidium (85.4678)  
**344** Strontium (87.62)  
**345** Yttrium (88.905848)  
**346** Zirconium (91.224)  
**347** Niobium (92.90638)  
**348** Molybdenum (95.94)  
**349** Technetium (98)  
**350** Ruthenium (101.07)  
**351** Rhodium (102.90550)  
**352** Palladium (106.3676)  
**353** Silver (107.8682)  
**354** Cadmium (112.411)  
**355** Indium (114.818)  
**356** Tin (118.710)  
**357** Antimony (121.757)  
**358** Tellurium (127.603)  
**359** Iodine (126.90447)  
**360** Xenon (131.29)  
**361** Barium (137.327)  
**362** Radium (226)  
**363** Actinium (227)

**TRANSITION METALS**

**364** Vanadium (50.9415)  
**365** Chromium (51.99616)  
**366** Manganese (54.938045)  
**367** Iron (55.845)  
**368** Cobalt (58.933195)  
**369** Nickel (58.6934)  
**370** Copper (63.546)  
**371** Zinc (65.38)  
**372** Gallium (69.723)  
**373** Germanium (72.63)  
**374** Arsenic (74.921595)  
**375** Selenium (78.96)  
**376** Bromine (79.904)  
**377** Krypton (83.80)  
**378** Rubidium (85.4678)  
**379** Strontium (87.62)  
**380** Yttrium (88.905848)  
**381** Zirconium (91.224)  
**382** Niobium (92.90638)  
**383** Molybdenum (95.94)  
**384** Technetium (98)  
**385** Ruthenium (101.07)  
**386** Rhodium (102.90550)  
**387** Palladium (106.3676)  
**388** Silver (107.8682)  
**389** Cadmium (112.411)  
**390** Indium (114.818)  
**391** Tin (118.710)  
**392** Antimony (121.757)  
**393** Tellurium (127.603)  
**394** Iodine (126.90447)  
**395** Xenon (131.29)  
**396** Barium (137.327)  
**397** Radium (226)  
**398** Actinium (227)

**TRANSITION METALS**

**399** Vanadium (50.9415)  
**400** Chromium (51.99616)  
**401** Manganese (54.938045)  
**402** Iron (55.845)  
**403** Cobalt (58.933195)  
**404** Nickel (58.6934)  
**405** Copper (63.546)  
**406** Zinc (65.38)  
**407** Gallium (69.723)  
**408** Germanium (72.63)  
**409** Arsenic (74.921595)  
**410** Selenium (78.96)  
**411** Bromine (79.904)  
**412** Krypton (83.80)  
**413** Rubidium (85.4678)  
**414** Strontium (87.62)  
**415** Yttrium (88.905848)  
**416** Zirconium (91.224)  
**417** Niobium (92.90638)  
**418** Molybdenum (95.94)  
**419** Technetium (98)  
**420** Ruthenium (101.07)  
**421** Rhodium (102.90550)  
**422** Palladium (106.3676)  
**423** Silver (107.8682)  
**424** Cadmium (112.411)  
**425** Indium (114.818)  
**426** Tin (118.710)  
**427** Antimony (121.757)  
**428** Tellurium (127.603)  
**429** Iodine (126.90447)  
**430** Xenon (131.29)  
**431** Barium (137.327)  
**432** Radium (226)  
**433** Actinium (227)

**TRANSITION METALS**

**434** Vanadium (50.9415)  
**435** Chromium (51.99616)  
**436** Manganese (54.938045)  
**437** Iron (55.845)  
**438** Cobalt (58.933195)  
**439** Nickel (58.6934)  
**440** Copper (63.546)  
**441** Zinc (65.38)  
**442** Gallium (69.723)  
**443** Germanium (72.63)  
**444** Arsenic (74.921595)  
**445** Selenium (78.96)  
**446** Bromine (79.904)  
**447** Krypton (83.80)  
**448** Rubidium (85.4678)  
**449** Strontium (87.62)  
**450** Yttrium (88.905848)  
**451** Zirconium (91.224)  
**452** Niobium (92.90638)  
**453** Molybdenum (95.94)  
**454** Technetium (98)  
**455** Ruthenium (101.07)  
**456** Rhodium (102.90550)  
**457** Palladium (106.3676)  
**458** Silver (107.8682)  
**459** Cadmium (112.411)  
**460** Indium (114.818)  
**461** Tin (118.710)  
**462** Antimony (121.757)  
**463** Tellurium (127.603)  
**464** Iodine (126.90447)  
**465** Xenon (131.29)  
**466** Barium (137.327)  
**467** Radium (226)  
**468** Actinium (227)

**TRANSITION METALS**

**469** Vanadium (50.9415)  
**470** Chromium (51.99616)  
**471** Manganese (54.938045)  
**472** Iron (55.845)  
**473** Cobalt (58.933195)  
**474** Nickel (58.6934)  
**475** Copper (63.546)  
**476** Zinc (65.38)  
**477** Gallium (69.723)  
**478** Germanium (72.63)  
**479** Arsenic (74.921595)  
**480** Selenium (78.96)  
**481** Bromine (79.904)  
**482** Krypton (83.80)  
**483** Rubidium (85.4678)  
**484** Strontium (87.62)  
**485** Yttrium (88.905848)  
**486** Zirconium (91.224)  
**487** Niobium (92.90638)  
**488** Molybdenum (95.94)  
**489** Technetium (98)  
**490** Ruthenium (101.07)  
**491** Rhodium (102.90550)  
**492** Palladium (106.3676)  
**493** Silver (107.8682)  
**494** Cadmium (112.411)  
**495** Indium (114.818)  
**496** Tin (118.710)  
**497** Antimony (121.757)  
**498** Tellurium (127.603)  
**499** Iodine (126.90447)  
**500** Xenon (131.29)  
**501** Barium (137.327)  
**502** Radium (226)  
**503** Actinium (227)

**TRANSITION METALS**

**504** Vanadium (50.9415)  
**505** Chromium (51.99616)  
**506** Manganese (54.938045)  
**507** Iron (55.845)  
**508** Cobalt (58.933195)  
**509** Nickel (58.6934)  
**510** Copper (63.546)  
**511** Zinc (65.38)  
**512** Gallium (69.723)  
**513** Germanium (72.63)  
**514** Arsenic (74.921595)  
**515** Selenium (78.96)  
**516** Bromine (79.904)  
**517** Krypton (83.80)  
**518** Rubidium (85.4678)  
**519** Strontium (87.62)  
**520** Yttrium (88.905848)  
**521** Zirconium (91.224)  
**522** Niobium (92.90638)  
**523** Molybdenum (95.94)  
**524** Technetium (98)  
**525** Ruthenium (101.07)  
**526** Rhodium (102.90550)  
**527** Palladium (106.3676)  
**528** Silver (107.8682)  
**529** Cadmium (112.411)  
**530** Indium (114.818)  
**531** Tin (118.710)  
**532** Antimony (121.757)  
**533** Tellurium (127.603)  
**534** Iodine (126.90447)  
**535** Xenon (131.29)  
**536** Barium (137.327)  
**537** Radium (226)  
**538** Actinium (227)

**TRANSITION METALS**

**539** Vanadium (50.9415)  
**540** Chromium (51.99616)  
**541** Manganese (54.938045)  
**542** Iron (55.845)  
**543** Cobalt (58.933195)  
**544** Nickel (58.6934)  
**545** Copper (63.546)  
**546** Zinc (65.38)  
**547** Gallium (69.723)  
**548** Germanium (72.63)  
**549** Arsenic (74.921595)  
**550** Selenium (78.96)  
**551** Bromine (79.904)  
**552** Krypton (83.80)  
**553** Rubidium (85.4678)  
**554** Strontium (87.62)  
**555** Yttrium (88.905848)  
**556** Zirconium (91.224)  
**557** Niobium (92.90638)  
**558** Molybdenum (95.94)  
**559** Technetium (98)

# *AFMS Code of Ethics*

- I will respect both private and public property and will do no collecting on privately owned land without the owner's permission.
- I will keep informed on all laws, regulations of rules governing collecting on public lands and will observe them.
- I will to the best of my ability, ascertain the boundary lines of property on which I plan to collect.
- I will use no firearms or blasting material in collecting areas.
- I will cause no willful damage to property of any kind - fences, signs, and buildings.
- I will leave all gates as found.
- I will build fires in designated or safe places only and will be certain they are completely extinguished before leaving the area.
- I will discard no burning material - matches, cigarettes, etc.
- I will fill all excavation holes which may be dangerous to livestock. [Editor's Note/Observation: I would also include wildlife as well as livestock.]
- I will not contaminate wells, creeks or other water supply.
- I will cause no willful damage to collecting material and will take home only what I can reasonably use.
- I will practice conservation and undertake to utilize fully and well the materials I have collected and will recycle my surplus for the pleasure and benefit of others.
- I will support the rockhound project H.E.L.P. (Help Eliminate Litter Please) and will leave all collecting areas devoid of litter, regardless of how found.
- I will cooperate with field trip leaders and the se in designated authority in all collecting areas.
- I will report to my club or Federation officers, Bureau of Land management or other authorities, any deposit of petrified wood or other materials on public lands which should be protected for the enjoyment of future generations for public educational and scientific purposes.
- I will appreciate and protect our heritage of natural resources.
- I will observe the "Golden Rule", will use "Good Outdoor Manners" and will at all times conduct myself in a manner which will add to the stature and Public "image" of rockhounds everywhere.

**MEMBERSHIP APPLICATION OR RENEWAL  
THE MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA (MSDC)**

(\_\_\_) Family ~ \$25.00 per year. One address.

(\_\_\_) Individual ~ \$20.00 per year.

(\_\_\_) New \* (\_\_\_) Renewal Dues are for Year \_\_\_\_\_\*

For new members who join in the last months of the year, membership will extend through the following year with no additional dues.

**ANNUAL DUES – PLEASE PAY YOUR DUES PROMPTLY.**

Pay at next meeting or mail to:  
Mineralogical Society of DC  
c/o John Weidner  
7099 Game Lord Drive  
Springfield, VA 22153-1312

Name(s) (First and Last) \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip: \_\_\_\_\_

Phone(s): Home/Work/Mobile \_\_\_\_\_

Email(s) \_\_\_\_\_

**OK TO INCLUDE YOU ON CLUB MEMBERSHIP LIST?**

( ) Yes – Include name, address, phone, email.

If you want any information omitted from the membership list, please note:

Omit my: ( ) Email, ( ) Home phone, ( ) Work phone, ( ) Mobile phone, ( ) Address, ( ) Name

**SPECIAL CLUB-RELATED INTERESTS?** \_\_\_\_\_

**MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA**

**(2017 Officers & Board Members)**

President: Dave Nanney, dnanney@cox.net

Vice President & Program Chair: Dave Hennessey, davidhennessey@comcast.net

Secretary: Andy Thompson, thompson01@starpower.net

Treasurer: John Weidner, (mail: 7099 Game Lord Dr, Springfield, VA 22153-1312)

Directors: Leslie Nanney, Ken Reynolds, Yury Kalish

Editor: Steve Johnson

Co-Web Masters: Betty Thompson & Casper Voogt, <http://mineralogicalsocietyofdc.org/>

**Meeting Dates, Time, and Location:** The first Wednesday of each month. (No meeting in July and August.)  
The National Museum of Natural History, Smithsonian Institution, 10<sup>th</sup> Street and Constitution Ave,  
Washington D.C. We will gather at the Constitution Avenue entrance at 7:45 PM to meet our guard who  
will escort us to the Cathy Kirby Room. Street parking: **Parking is available in the Smithsonian Staff Parking**  
**– Just tell the guard at the gate that you are attending the Mineral Club Meeting.**



***THE MINERAL MINUTES***

*Permission to copy material printed herein, except specifically copyrighted items, is granted, provided credit is given.*

Newsletter of the Mineralogical Society of the District of Columbia

Mineralogical Society of DC

Time Sensitive Dated Material  
First-Class Mail