The Mineral Minutes

Volume 79-03
March 2021

Zoom Meetings Continue

Please connect to our March program at our usual time and date: **Wednesday, March 3, 2021** at **7:30 pm Eastern Time**. You should receive a link in an email from the MSDC Treasurer, John Weidner. If you do not, please email John (jfweidner42@ gmail.com) and he will send you the link.

March 3, 2021 Program: "Biominerals" by Gabriela Farfan

by Yury Kalish, MSDC Vice President

Dr. Gabriela Farfan will be our presenter in March. Gabriela is the Coralyn W. Whitney Endowed Curator of Gems and Minerals at the National Museum of Natural History (NMNH) at the Smithsonian. She earned her Bachelor's degree from Stanford and Ph.D. from the joint program between the MIT and the Woods Hole Oceanographic Institution. Since coming to the Smithsonian as Peter Buck Postdoctoral Fellow in 2019, Gabriela became interested in the MSDC and is now a member of our club. Gabriela is therefore continuing the long history of strong ties between the MSDC and the Smithsonian.

Gabriela's research interests include bio- and geo-formed carbonates such as aragonite and calcite, and amorphous silica such as opal and glass. Her presentation will focus on bio minerals. Specifically, she will discuss her research on aquatic biomineralizers such as corals, mollusks, and diatoms. As one example, Gabriela will highlight her work on freshwater pearls as recorders of their local environments. Gabriela's presentation will provide an opportunity to peak behind the scenes at the scientific research process at the Smithsonian.

Sharing Time

by Dave Hennessey, MSDC President

We generally try to steer the focus for our sharing time to the presentation topic of our meeting. With biominerals as our presentation focus, gallstones and kidney stones come to mind! Only kidding. Besides, when my gall bladder was removed last January, I asked beforehand if I could have the gallstones and they said no. Apparently, there are restrictions on that kind of thing. As I understand it, biominerals are things like teeth, bones, and shells. If you have biominerals in your collection to share we would love to see and hear about them. If not, please share something else that gives you pleasure. Any specimen you find worthy of your attention, we will enjoy too.

Issue Highlights:

Prez Says…

by Dave Hennessey, MSDC President

It has officially been one year since I have seen any of you face-to-face. Our last in-person meeting was last March, 2020. I miss you all. Zoom is nice but it does not replace being able to get together in person. *(continued on p. 2)*

("Pres Says…" continued from p.1)
I belong to four local gem and mineral clubs and pre-COVID I tried to make it to all the meetings of all four clubs. I am a minerals guy, so I sometimes would skip presentations on fossils or lapidary, but I actually made it to a lot of those meetings too, to enjoy the camaraderie of my fellow club members. For keeping in touch, Zoom is better than nothing, but I long for the time when we will again be able to meet in person.

Zoom has kept our head above water, but lately I have been drowning in hobby-related Zoom meetings. In addition to my four local club Zoom meetings there are EFMLS Zoom meetings, and Virginia Mineral Project/Friends of Mineralogy-Virginia, and various other Zooming opportunities. Clubs nationwide have been sharing invitations to their Zoom meetings and I have attended the Zoom meetings of clubs in Pennsylvania, Baltimore, Arizona, and New York. I am convinced that without too much additional effort I could find a mineral-related Zoom meeting every night of every week of every month. There are virtual shows and symposia also available and if there is still a free minute, YouTube is filled with content. Virtual mineral collecting trips, virtual club meetings that were recorded in case I wasn't able to Zoom live, How-To videos on mineral cleaning and presentation, etc. My state university system will also let me sign up and take virtual classes in geology (for free since I am over age 65!).

I love my hobby, but I find that I am going to have to draw a line. I am suffering from an overload of available hobby information opportunities. Someone wise once recommended "moderation in all things", maybe Ben Franklin or Oscar Wilde. Moderation is tough. If it were easier my weight would be perfect for my height. As it is, I am undertall. Regarding my lack of moderation in Zooming, I am resolving to do less of it and am heartily looking forward to once again meeting in person, maybe this fall if all goes well with vaccine rollout. In the meantime, I'll see you all on March 3rd, via Zoom.

February 2021 Business Meeting

by Andy Thompson, MSDC Secretary

Summary: President Dave Hennessey called the meeting to order. He thanked all for attending our February Zoom meeting, including three past presidents of MSDC. He expressed his special appreciation to Tim Rose, our club's sponsor at the Smithsonian, who joined the meeting. Dave warmly welcomed all the guests. Dave also thanked Ken Rock who did an excellent job editing and producing the January and February Mineral Minutes newsletters and continued the fine contributions made by Yury, his immediate predecessor. Dave called for and received a motion to approve the Business Meeting Summary as it appeared in the February edition. The motion was seconded and approved unanimously, with no changes recommended.

Treasurer's Report: John Weidner reported the club's membership level and its revenue and expenses.

Old and New Business: No old or new issues were raised. There was discussion of the impact of COVID-19 on local clubs' annual mineral shows. Dave M. called attention to the Atlantic Micromounters' Conference which will be held Saturday, April 10, from 1 to 4 pm via Zoom. A presentation will be made by Mike Seeds and another by Quinton Wight. An on-line auction also will be held. For more information, visit the DC Microminerals website. Dave H. then announced that on February 6, the MSDC board of directors would hold a meeting via Zoom. He encouraged MSDC members to attend or to submit any questions to him that they may have for the board.

Geology in the News: Dave asked if members had any geology-related news to report and Tim Rose provided an interesting geologic update, complete with a photo, of the Kilauea volcano in Hawaii. Tim, who for decades has been conducting and publishing field research concerning Hawaiian volcanism, reminded us that the Kilauea caldera had collapsed in 2018 and began filling with water. More recently, lava has replaced the water and Tim pointed out a floating dark mass in the middle of the lava lake at the caldera bottom. He noted some people refer to the mass as an "island." He explained that because it floats, it is more properly referred to as a "raft" or "basalt berg." The question the raft raises is why it is floating.

Tim noted that “in theory, a mass of basalt, being denser than the lava, should sink. But it floats." He theorized that the heavy lava is probably filled with a massive amount of bubbles which give it buoyancy within the pool of lava. He recommended that anyone interested could view the spectacle via the Hawaiian Volcanoes Observatory website web camera KWcam. The KWcam shows a live panorama of Halemaʻumaʻu from the west rim of the Kilauea caldera (usgs.gov). In the continually updated time-lapse photos, the dark irregular raft is evident toward the far edge of the caldera lava pool. It is an amazing sight to watch.

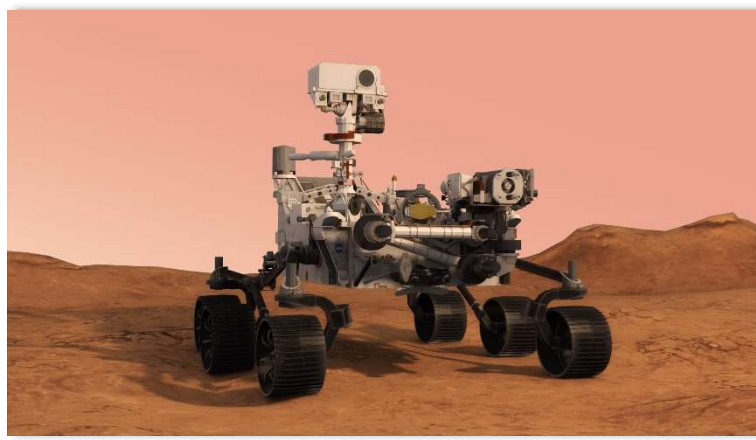
Jeff G. provided another important piece of “Geology in the News,” the recent discovery of the mineral jarosite in the core deep-drilling project in Antarctica. This mineral was discovered in 2004 in multiple places on Mars by the Opportunity rover. Jeff, Dave H. and others discussed those events and identified jarosite as a potassium and iron hydrous sulphate mineral that points to the earlier presence of water on Mars. The Perseverance rover was expected to land on Mars on February 18 and continue to explore the mineralogy of Mars for ancient signs of life.

With no further discussion, Dave called for and received a motion and unanimous vote to close the business meeting. He then turned the program over to Yury to introduce the evening’s presenter.

Collecting Martian Soil & Rocks

by Ken Rock, MSDC Editor

As most of us know, the NASA Perseverance rover landed safely on Mars on February 18 after a journey of nearly 300 million miles. The successful deployment of the rover via “sky crane” has got to be one of the most impressive demonstrations of robotics ever. Equally impressive, in my opinion, are plans for the Perseverance to drill into Marian soil and rocks using a number of drills to collect core samples and place them in tubes in a process called “sample caching.”



Somewhere between 30 and 43 samples will be collected, placed in tubes, hermetically sealed, and stored in the belly of the rover. Strict cleanliness requirements have been established to avoid contaminating the samples with any materials originating on earth.

At a later time, the samples will be deposited on the Martian surface at one or more locations to be designated as a "sample cache depot." These tubes would be left on the Martian surface for retrieval by a subsequent Mars mission, probably no earlier than 2031. As you might expect, detailed maps using local landmarks and precise coordinates from orbital measurements will be provided so that any future mission to Mars and can pick up these samples for study back on earth.

At present, martian meteorites are the only direct samples from Mars. Currently, there are a total of 262 individual samples originating from at least 11 ejection events. The number of samples has almost doubled over the past six years, affording an opportunity to study these meteorites as suites of igneous rocks. Geochemical analyses, using techniques that also are used on terrestrial rocks, provide fundamental insights into geological processes that have occurred on Mars. Martian meteorites display a wide range in mineralogy and chemistry, but are predominantly basaltic in composition. However, the geology of Mars cannot be unraveled solely by analyzing these meteorites.

Rocks analyzed by rovers on the surface of Mars reveal a composition that is different from that of meteorites from Mars. The Mars 2020 mission plans to collect older samples directly from the Jezero crater on Mars's surface, for eventual return to Earth. The study of both meteorites and returned samples is essential to gain a full understanding of the interior composition, evolution, and geological characteristics of different locations on Mars. These facts highlight the importance of Mars missions, especially the return of samples from the red planet.

Terminology Refresher

Asteroid: A big (>1 meter) rock or aggregation of rocks orbiting the sun

Meteoroid: A small (<1 meter) rock orbiting the sun

Meteor: The visible light that occurs when a meteoroid passes through the Earth's atmosphere

Meteorite: A rock found on Earth that was once a meteoroid.

You may view a 3-D model of the Perseverance here. You can download a more detailed version of the model, as well, from this NASA website. NASA also periodically updates its website with **news** and updates from Mars. (Check it out!)

Information about Martian meteorites is being used, with the author's permission, from an article, "What Martian Meteorites Reveal About the Interior and Surface of Mars," by A. Udry et al., published in JGR Planets, 20 November 2020. An abstract and summary is available here.

February 3rd MSDC Program Presentation:
"The Universe in a Micro Box"
Presented by Mike Seeds, Emeritus Professor of Astronomy

Synopsis by Andy Thompson (Secretary)

"Hydrogen and helium atoms were made in the big bang, but where did all of the heavier elements come from?"

Presenter Mike Seeds combined his love of minerals and his experience as a professor of astronomy to tell the story of how different types of stars have made the atoms in minerals and in our bodies. As the former President of the Baltimore Mineral Society and retired from teaching astronomy for 32 years at Franklin and Marshall College, Mike drew on his interdisciplinary vision and told the fascinating and quite new and evolving story of how the chemical elements and minerals of the universe have come into being.

Simply put, nearly all of the elements were cooked up in stars and, in some cases, blasted into existence in cataclysmic explosions called supernovae. Mike's talk was richly illustrated with images of galaxies and exploding stars, along with photos Mike himself took of diverse minerals, many being micros, as suggested by his presentation's title: "The Universe in a Micro Box."

The following synopsis may, at times, seem technical. But Mike's delivery had the simplicity typical of a well-told story that was easily listened to by all in his audience.

Mike began by providing describing our Milky Way Galaxy, which hosts our solar system, with its relatively normal-sized sun, circled by eight planets, with four smaller rocky ones closer to the sun and four gassy ones toward the outside. He noted that our Earth has an 8,000-mile diameter and it would take 109 earths, side by side, to span the diameter of the sun. He noted the sun is essentially gases, primarily hydrogen, while the Earth's crust has oxygen as its most abundant element.

He raised the tantalizing question of how many stars are in the Milky Way. He suggested 300 billion is a good estimate, but, as scientists probe further and learn more, we may come to think of the actual number as being much larger. Mike cited the Hubble telescope's relatively recent finding that helped change the way astronomers understand the make-up of the universe. Astronomers pointed the telescope toward what appeared to be a tiny, dark region of our Milky Way galaxy which was thought to be devoid of stars. But they used a much longer exposure time of 11.3 days. The resulting photo is famously known as the Hubble Ultra-Deep Field and it contained an additional 10,000 previously unseen galaxies, many reaching back 13 billion years, closer to the original time of the Big Bang. Mike said that in that photo, he counted only two previously unknown Milky Way stars, with all the other lights being galaxies. He suggested that with future research of our galaxy, there could be closer to 400 billion stars in our Milky Way.

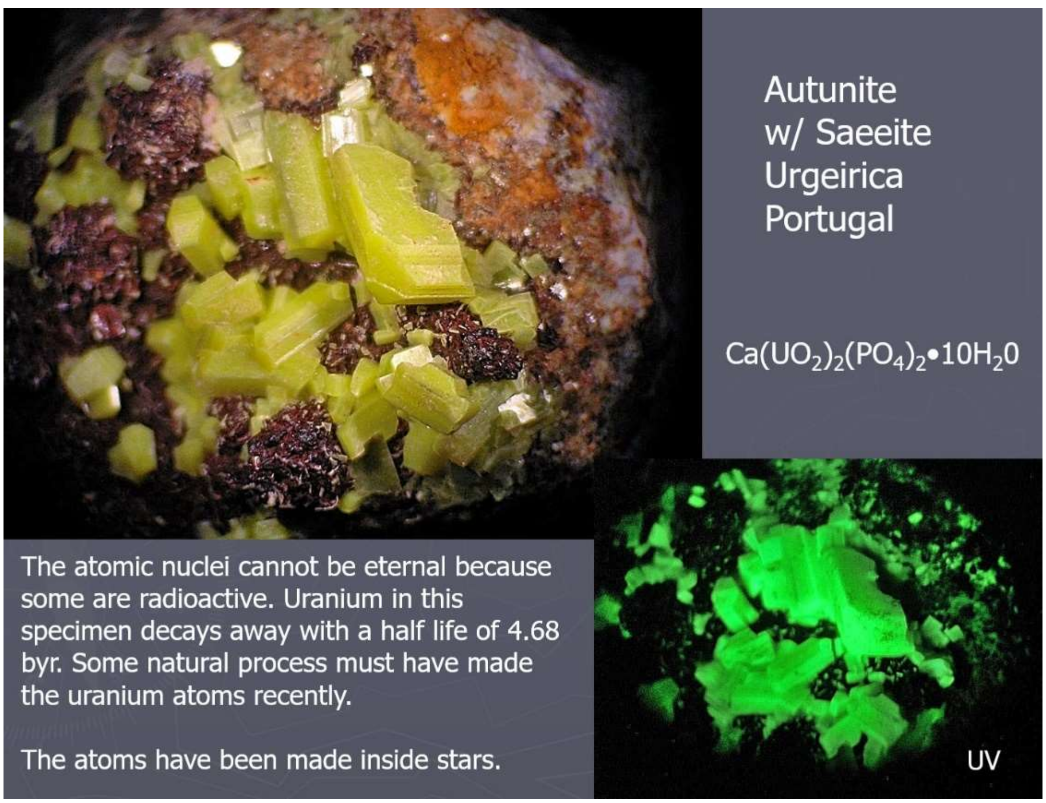
Mike also raised the question of whether there were other forms of life beyond our Earth and galaxy. He suggested that with there being over a trillion galaxies in the universe, and with about half of them thought to have planetary systems, it would be highly unlikely that Earth alone supported life.

The Birth of Stars

In describing how stars were born after the Big Bang, Mike described vast clouds of sub-atomic particles first forming atoms, then molecules and uneven compressions in the gas clouds. Those thicker masses generated gravitational forces which pulled the gases together into giant gas balls whose rotation eventually generated high temperatures, resulting in combustion and the birth of burning stars.

At high gravitational pressures and temperatures, the simple hydrogen atoms could fuse together into helium atoms, thereby starting the process eventually leading to the formation of heavier elements. With increased rotation speeds and higher temperatures, the gases and stars form what we today recognize as spinning galaxies. Mike said our Milky Way galaxy formed 4.5 billion years ago.

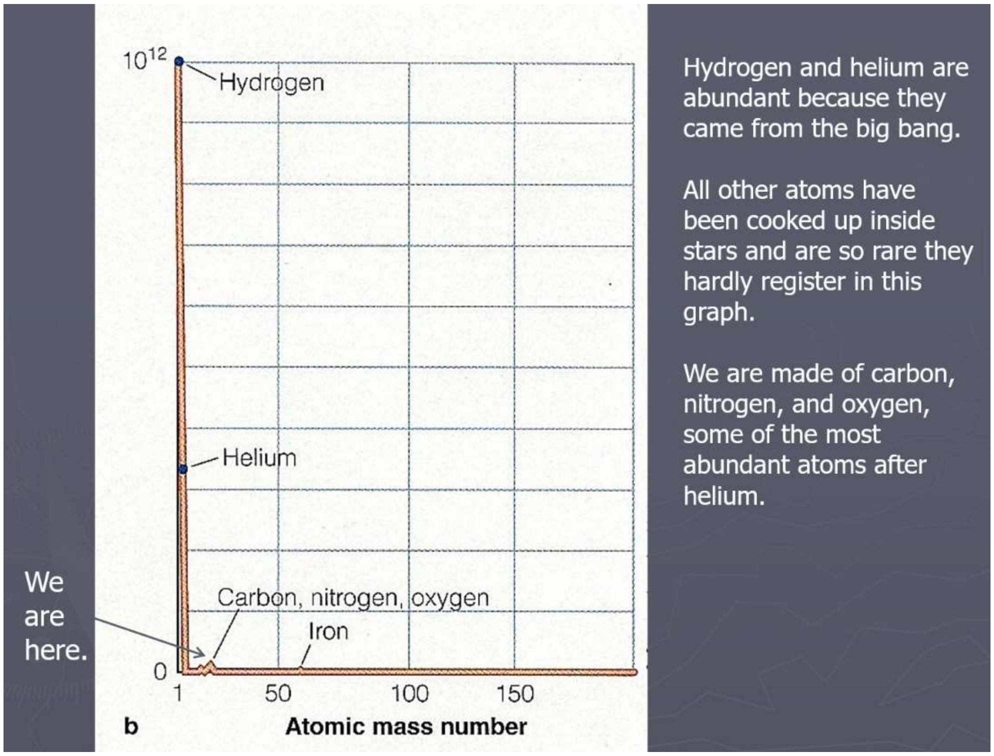
After giving his presentation of more than 40 slides to the MSDC Zoom audience, Mike returned home and prepared a separate set of seven slides specifically for this synopsis. His intent was to allow MSDC Mineral Minutes readers to get the gist of the rest of his story about the formation of our universe and how the heavier elements found in the Periodic Table came into existence.



He began this mini-lesson by addressing the questions: How do we know the atomic nuclei did not always exist? Why do we think they are made in stars?

◄ Mike's first image above illustrates the mineral **autunite** which, as indicated in its chemical formula, contains the radioactive element uranium. Because we have measured that element's half-life (its rate of decay) as 4.68 billion years, we know it does not last forever. Therefore, the uranium must have been forged in the intense heat inside stars, specifically within merging neutron stars.

A second question is why astronomers and scientists believe the elements hydrogen and helium are the most abundant elements in the universe? Further, why do we associate the formation of hydrogen and helium atoms with the Big Bang?



◄ Mike provided this **chart comparing the relative amounts of the elements detected in our solar system's sun.** The chart indicates the most abundant element is hydrogen, with helium being second and only tiny amounts of carbon, nitrogen and oxygen, in that order. Iron holds the distant 6th place. Mike pointed out that these are the very chemical elements, except for helium, of which human beings are composed. Each person's body is indeed composed of atoms that were generated in the stars. It is not a metaphor or opinion but science.

The chart also indicates that throughout the universe, hydrogen and helium are, by far, the most abundant elements. This suggests that the simpler the atomic structure of the atom, the more it is in abundance. Hydrogen, with an atomic number of 1 is the most abundant (the atomic number is the number of protons in an atom of an element). Helium is 2 and is second most abundant. Elements having a higher atomic number, weight and complexity are less abundant.

During his presentation, Mike noted that the chemical composition of individual stars can be determined because each of the chemical elements comprising the stars absorbs a particular wavelength of light. By sorting out the wavelengths of the light coming from a star, its photograph or spectrograph tells us the primary elements of which the star is composed and the abundance of each of those elements.

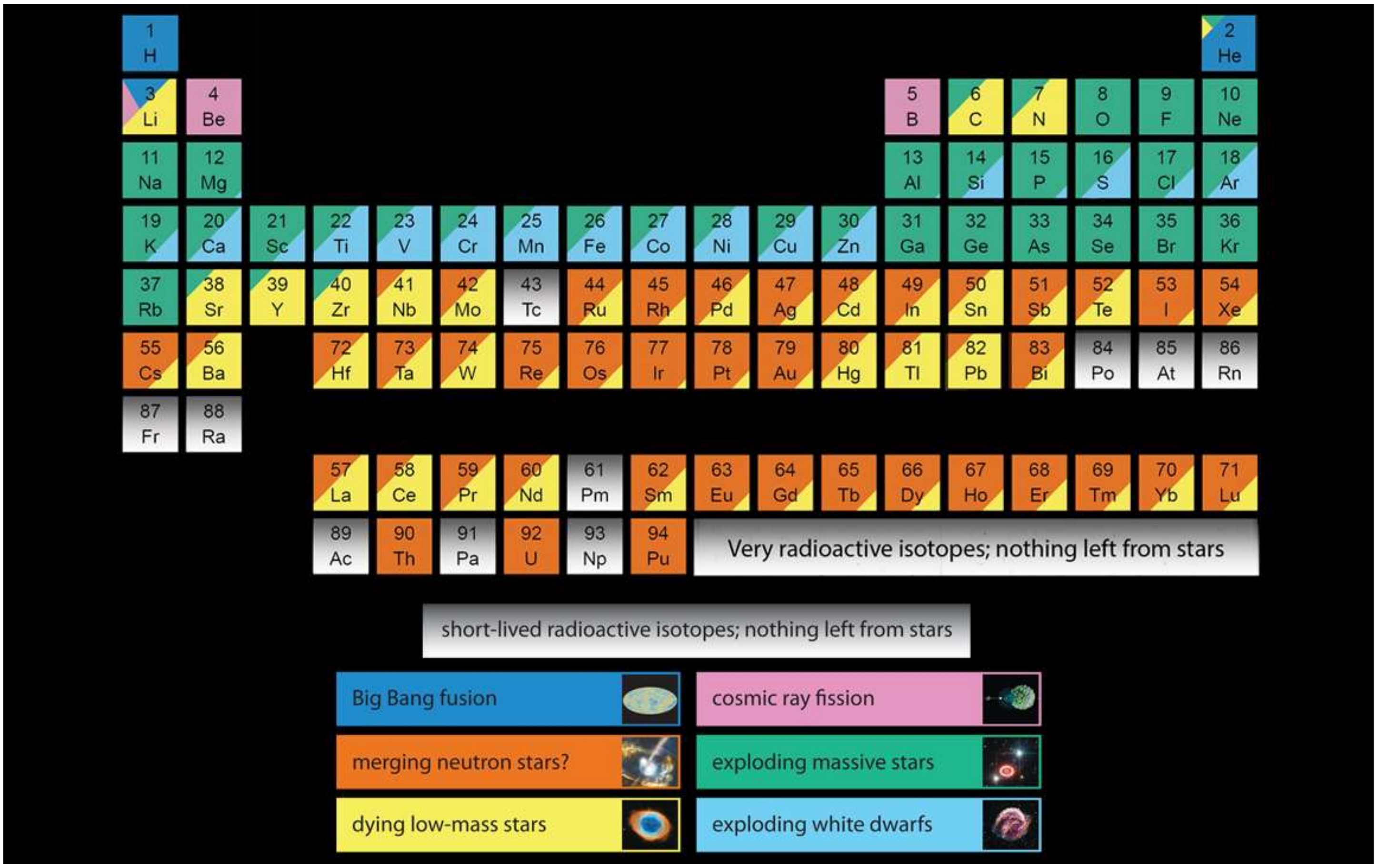
Mike displayed a unique form of the **Periodic Table** that was not available to scientists until about 2017. In it, the box for each of the elements is color-coded to indicate from which type of stelar activity each specific element was produced. Astronomer Jennifer Johnson and her colleagues published this in *American Scientist* (2018, Sept./Oct. Vol 106, #5, p. 265), in a ground-breaking article: *"A Chemical History of the Universe."*

Each of the elements' boxes in her version of the Periodic Table is shaded in one, two, or three colors, indicating the probable star type or explosion which brought about that element's formation. The carbon box, for example, with atomic number of 6, is mostly yellow, indicating most carbon originated in "dying low-mass stars," one of the six categories of stars from which the elements were produced.

The link to that article is provided beneath the chart which follows. Mike suggested there are many incorrect versions of this Periodic Table and so he strongly recommended the version provided below.

Note that the graphic on the next page is a combination of two images. The upper, larger portion is the Periodic Table. The smaller portion is the index of four types of stars, a fission and fusion event, making up the six color codes for identifying how the each of the elements are made, as explained below.

The color-coded Periodic Table and smaller index distinguishing the six different types of stars or cosmic events may be viewed here.



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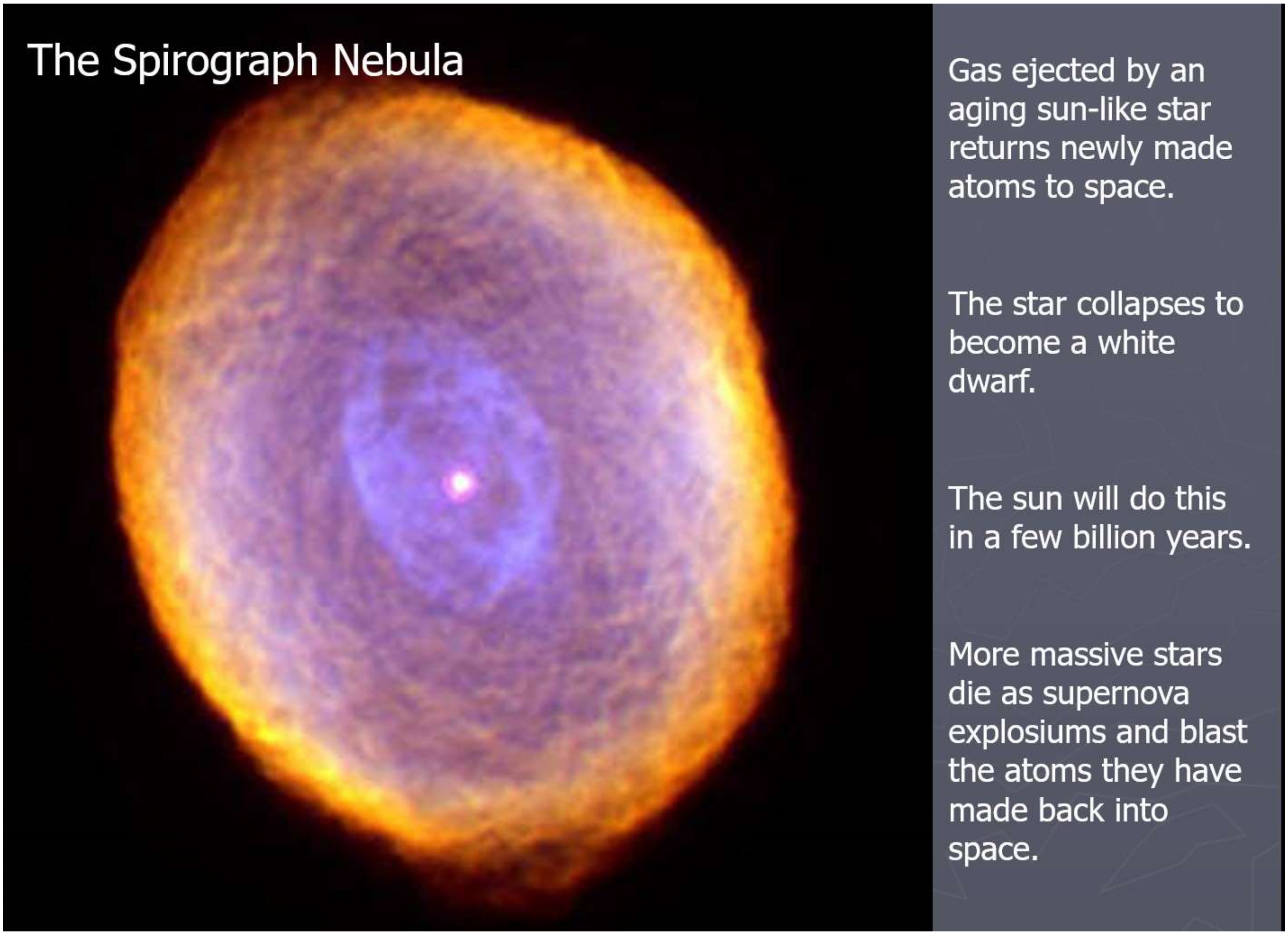
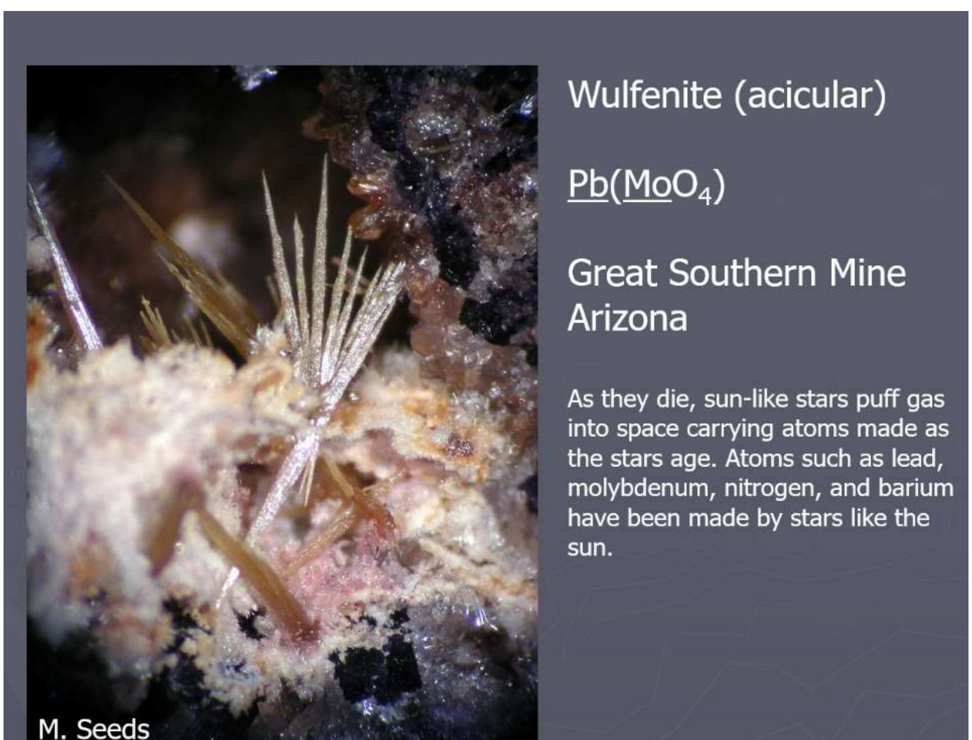
The Story of the Expanding Universe

Mike then continued the story of the formation of the universe by describing the dynamic events, about 14 billion years ago, immediately after the big bang. Within the first three minutes, hydrogen and helium were, for all practical purposes, the only chemical elements that existed. With that expansion came a cooling down from the initial intense heat of the big bang explosion. As a result, the formation of the next heavier elements, lithium and beryllium, came about more slowly, as the smaller atoms of hydrogen and helium, along with their heavier forms due to added neutrons, coalesced like building blocks, generating larger and heavier elements.

Mike said he prefers to always include the chemical formula of the minerals he photographs and discusses. By showing the chemical elements present in the mineral, and when practical, their respective atomic numbers (protons), the viewers are playing with a fuller deck.

▼ With the growth of the gas clouds came wrinkles, or variations, in the density of the gassy material. That process eventually compressed gigantic gas clouds, as illustrated in the **Spirograph Nebula** on the next page. The dynamics of star formation then came into play which included the two forces: 1) increasing gravity which compressed matter toward a core, and 2) the center-fleeing opposite force of exploding gases and energy which pushed stellar material outward, as noted in the Nebula slide's text. That dynamic, over billions of years, depending on the sizes and temperatures, generated the six different types of star formation illustrated by Jennifer Johnson's smaller color-coded listing found beneath the Periodic Table above.





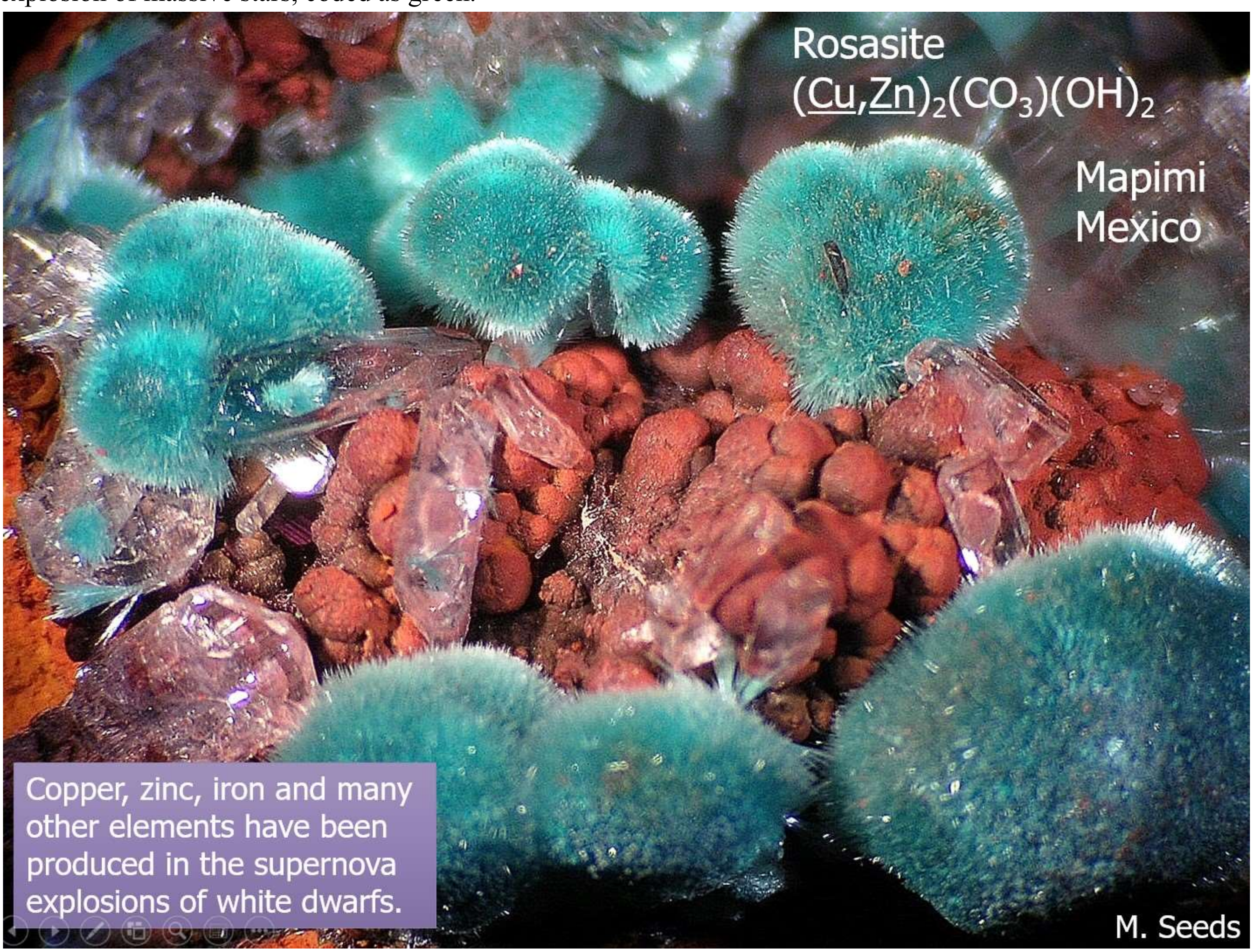
The result of these diverse stellar dynamics is the generation of increasingly heavier elements. Mike's colorful slides, below, provide examples of those heavier elements found in mineral specimens. In each of the following three slides, Mike identifies one or more of those increasingly heavier elements and the corresponding type of star or explosion which allowed the minerals' formation by fusions of smaller elements' atoms.

◄ **Wulfenite**, the needle-like mineral shown here, contains lead (Pb 82) and molybdenum (Mo 42) as noted in the sidebar text. Those minerals, along with nitrogen (N 7) and barium (Ba 56) are made by aging and dying sun-like stars. In the color-coded periodic chart, those elements are color-coded as yellow, the "low mass stars," such as our sun, which produce the lead, molybdenite, nitrogen, and barium.

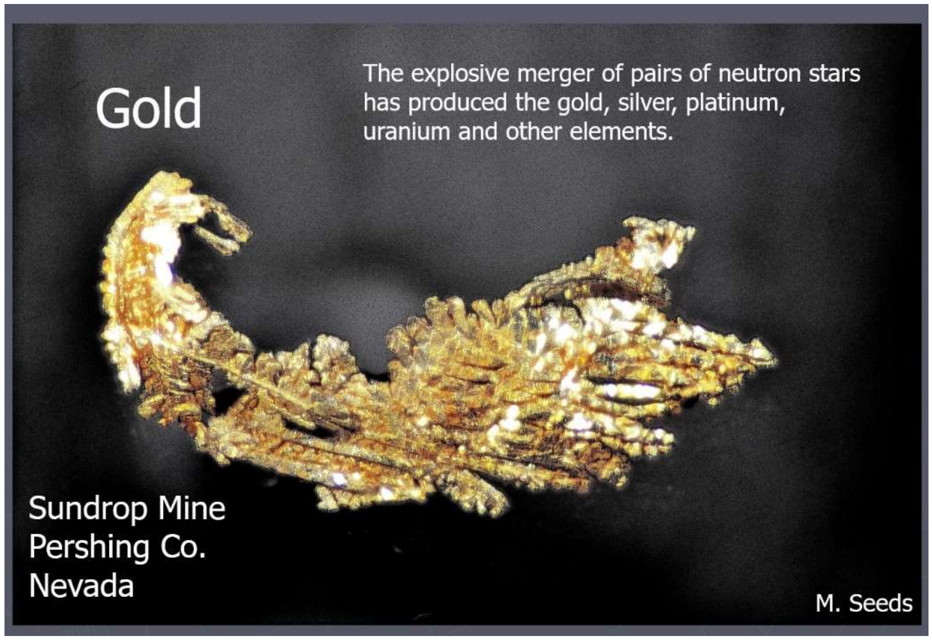
► As another example, the mineral **natrolite** contains the slightly heavier elements sodium (Na 11), aluminum (Al 13), and silicon (Si 14). Those elements were produced in a supernova explosion of a massive star, shown as green in the smaller chart. In the Periodic Table, those three elements, are also shown as green.

The supernova explosion of massive stars produces all of the atoms in natrolite except for the hydrogen.

▼ A third example is shown in this stunning photograph of the mineral **rosasite** which contains a mix of the elements copper (Cu 29), zinc (Zn 30) and iron (Fe 26). These elements were forged in the supernovae of exploding white dwarfs. The smaller chart of the six types of stars codes this star as light blue, and accordingly, the squares of each of the three elements also are partially colored in light blue, indicating that those elements are produced by white dwarfs as well as by the explosion of massive stars, coded as green.



► Mike's final example is the mineral specimen **gold**, shown to the right. It is an example of heavier elements that are produced by the very high-energy, explosive merger of two neutron stars. Gold (Au 74), silver (Ag 47) platinum (Pt 78) and uranium (U 92), along with additional heavier elements, all have an abundance of neutrons. This fusion of smaller atoms into larger elements requires the greater heat and pressure of these stars in order to bond the smaller atoms and produce larger atoms. Those heavier elements and the neutron star mergers are represented in the tables by the color orange.



In addition to the minerals formed in stars, Mike noted that some atoms are made in relatively empty space when unstructured, low density gas clouds become bombarded by cosmic rays. That process can result in the fission or splitting up of larger atoms into the atoms of very light elements, such as lithium (Li 3), beryllium (Be 4) and boron (B 5). Those atoms are shown as pink in the Periodic Table and smaller chart.

During the course of Mike's presentation, he shared over 40 of his own photographs of beautiful mineral specimens and talked about their diverse stellar origins. Mike generously crafted the above 7 slides, with accompanying explanatory texts, simply to assist with this synopsis of his presentation.

In conclusion, Mike stressed the factual reality that the atoms constituting our bodies and all the objects in our world are all recycled atoms not only from stars but also from bacteria, plants, and dinosaurs. This reality, he said, was not an opinion, but a mathematically determined reality. For humans, the formation of the chemical elements is personal and central to who we are and from where we came.

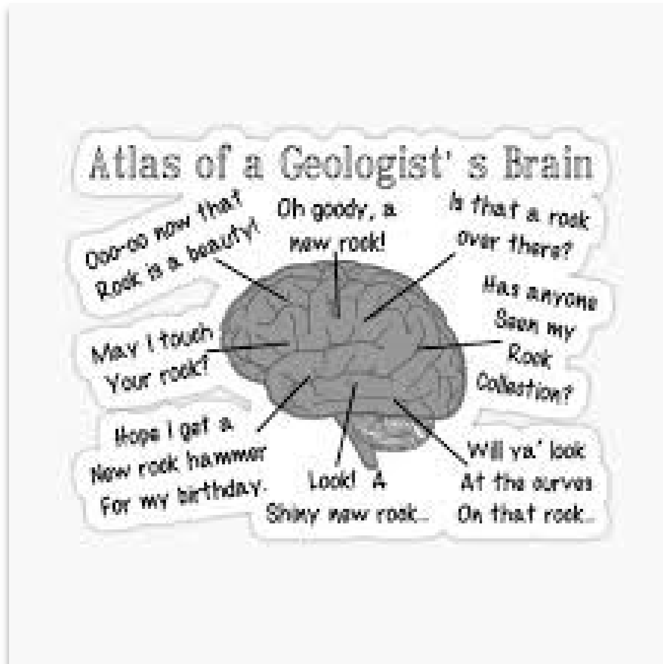
The Zoom audience applauded Mike's excellent presentation. MSDC president Dave Hennessey thanked Mike for sharing his interdisciplinary perspectives of astronomy and mineralogy. He then invited questions from the attendees.

The many queries and discussions ranged from where diamonds originated in the star formation process (i.e., from carbon which Mike said is very common in the universe), to any information about Robert Hazen's newly proposed system of mineral classification based on their formation processes (described in a separate article later in this month's newsletter), to where, during the big bang, did anti-matter go (a mystery, but Mike noted it happened in more than one part of the universe).

Sharing Time: Mineral Show and Tell

Dave Hennessey again thanked Mike for his presentation and invited attendees to hold their well-lighted minerals up to their computer camera or smart phone lens and share any relevant information. Alex, Dave N, Dan, Ken, Jeff and others provided colorful background information on the diverse specimens they shared with the group. Dave thanked all for participating and noted that MSDC members were looking forward to our **March 3rd** presentation on **"Bio-Minerals"** by **Dr. Gabriella Farfan**, the Coralyn W. Whitney Endowed Curator of Gems and Minerals in the Department of Mineral Sciences at the Smithsonian's Natural History Museum.

Humor Section



Scientists and Philosopher Team Propose a New Way to Categorize Minerals

News Release from the Carnegie Institution for Science, 21 December 2020

Washington, DC -- *A diamond lasts forever, but that doesn't mean all diamonds have a common history.*

Some diamonds were formed billions of years ago in space as the carbon-rich atmospheres of dying stars expanded and cooled. In our own planet's lifetime, high-temperatures and pressures in the mantle produced the diamonds that are familiar to us as gems. 5,000 years ago, a large meteorite that struck a carbon-rich sediment on Earth produced an impact diamond.

Each of these diamonds differs from the others in both composition and genesis, but all are categorized as "diamond" by the authoritative guide to minerals--the International Mineralogical Association's (IMA's) Commission on New Minerals, Nomenclature and Classification. For many physical scientists, this inconsistency poses no problem. But the IMA system leaves unanswered questions for planetary scientists, geobiologists, paleontologists and others who strive to understand minerals' historical context.

Carol Cleland. CU Boulder photo by Glenn Asakawa

So, Carnegie's Robert Hazen and Shaunna Morrison teamed up with University of Colorado (CU) Boulder philosophy of science professor Carol Cleland to propose that scientists address this shortcoming with a new "evolutionary system" of mineral classification--one that includes historical data and reflects changes in the diversity and distribution of minerals through more than 4 billion years of Earth's history. Their work is published by the *Proceedings of the National Academy of Sciences*. "We came together from the very different fields of philosophy and planetary science to see if there was a rigorous way to bring the dimension of time into discussions about the solid materials that compose Earth," Hazen said.

The IMA classification system for minerals dates to the 19th century when geologist James Dwight Dana outlined a way to categorize minerals on the basis of unique combinations of idealized compositions of major elements and geometrically idealized crystal structure. "For example, the IMA defines quartz as pure silicon dioxide, but the existence of this idealized version is completely fictional," said Morrison. "Every specimen of quartz contains imperfections--traces of its formation process that makes it unique." This approach to the categorization system means minerals with distinctly different historical origins are lumped together--as with the example of diamonds--while other minerals that share a common causal history are split apart.

"The IMA system is typical," said lead author Cleland, explaining that most classification systems in the natural sciences, such as the periodic table of the elements, are time independent, categorizing material things "solely on the basis of manifest similarities and differences, regardless of how they were produced or what modifications they have undergone." For many researchers, a time-independent system is completely appropriate. But this approach doesn't work well for planetary and other historically oriented geosciences, where the emphasis is on understanding the formation and development of planetary bodies. Differences in a diamond or quartz crystal's formative history are critical, Cleland said, because the conditions under which a sample was formed and the modifications it has undergone "are far more informative than the mere fact that a crystal qualifies as diamond or quartz." She, Hazen, and Morrison argue that what planetary scientists need is a new system of categorizing minerals that includes historical "natural kinds."

Biology faced an analogous issue before Darwin put forward his theory of evolution. For example, lacking an understanding of how organisms are historically related through evolutionary processes, 17th century scholars debated whether bats are birds. With the advent of Darwin's work in the 19th century, however, biologists classified them separately on evolutionary grounds, because they lack a common ancestor with wings.

Diamond Crystal. Image by Pat Daly

Because a universal theory of "mineral evolution" does not exist, creating such a classification system for the geosciences is challenging. Hazen, Morrison, and Cleland's proposed solution is what they call a "bootstrap" approach based on historically revelatory, information-rich chemical, physical, and biological attributes of solid materials. This strategy allows scientists to build a historical system of mineral kinds while remaining agnostic about its underlying theoretical principles.

"Minerals are the most durable, information-rich objects we can study to understand our planet's origin and evolution," Hazen said. "Our new evolutionary approach to classifying minerals complements the existing protocols and offers the opportunity to rigorously document Earth's history." Morrison concurred, adding: "Rethinking the way we classify minerals offers the opportunity to address big, outstanding scientific mysteries about our planet and our Solar System, through a mineralogical lens. In their imperfections and deviations from the ideal, minerals capture the story of what has happened to them through deep time--they provide a time machine to go back and understand what was happening on our planet and other planets in our solar system millions or billions of years ago."

The Carnegie Institution for Science (carnegiescience.edu) is a private, nonprofit organization headquartered in Washington, D.C., with three research divisions on both coasts of the U.S.

Note from Dave Hennessey, MSDC President: *One of the authors, Dr. Shaunna Morrison, was the mentor of a young lady, Cadence Boucher, who made a presentation to our club on Mineral Network Analysis in September 2019. Shaunna came to our club meeting that night and helped Cadence with the presentation and fielding questions.*

MSDC Club Information

Due to COVID-19, our meetings will be virtual over Zoom. No in-person meetings are planned until further notice. In non-COVID times, meetings are the First Wednesday of the Month (Jan-Jun and Sep-Dec). We meet in the Constitution Avenue lobby of the Smithsonian National Museum of Natural History at 7:30 pm.

Website: http://mineralogicalsocietyofdc.org/

Facebook: www.facebook.com/Mineralogical-SocietyOfTheDistrictOfColumbia

2021 Officers and Directors

President - Dave Hennessey | davidhennessey@comcast.net

Vice President - Yury Kalish | yury.kalish@gmail.com

Secretary - Andy Thompson | thompson01@starpower.net

Treasurer - John Weidner
Mailing address for dues: 7099 Game Lord Dr, Springfield, VA 22153-1312

Directors
Ken Reynolds | kennyreynolds62@gmail.com
Dan Teich | danteichdvm@yahoo.com
Alex Venzke | alex.venzke27@gmail.com

Webmasters
Betty Thompson | bdthompson01@yahoo.com
Casper Voogt | casper.voogt@gmail.com

Newsletter Editor
Ken Rock | kennethnrock@gmail.com

THE MINERAL MINUTES

NEWSLETTER OF THE MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA

Mineralogical Society of DC
Time Sensitive Dated Material

Essentially every scientist, when posed with the question, "If you want to get science knowledge from Mars, do you want to send a geologist or do you want to send a robot?" Well, the real answer is, you can send 100 robots for the price of sending one geologist, so let's send 100 robots to 100 different locations, and then we would all benefit. So that's the answer you would get. And I agree with that answer. — **Neil deGrasse Tyson**

Useful Mineral Links

	American Federation of Mineralogical Societies (AFMS)	www.amfed.org
	Eastern Federation of Mineralogical and Lapidary Societies (EFMLS)	www.efmls.org
	MINDAT	www.mindat.org
	Micromineralogists of the National Capital Area	www.dcmicrominerals.org
	Mineralogical Society of America (MSA)	www.minoscam.org
	Friends of Mineralogy	www.friendsofmineralogy.org
	WebMineral	www.webmineral.com
	The Geological Society of America (GSA)	www.geosociety.org
	Jeff Scovil Mineral Photography (not advertising - just great photos)	www.scovilphotography.com
	United States Geological Survey (USGS)	www.usgs.gov
	The Geological Society of Washington (GSW)	www.gswweb.org

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 in-person 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? ______________________________

Meeting Dates, Time, and Location: The first Wednesday of each month; no meeting in July or August.

(**Due to COVID-19, our meetings will be virtual over Zoom. No in-person meetings are planned until further notice.** Normally, the MSDC meetings take place at the National Museum of Natural History, Smithsonian Institution, 10th Street and Constitution Ave, Washington DC. We usually gather at the Constitution Avenue entrance at 7:30 pm to meet our guard who escorts us to the Cathy Kerby Room.)