



The Mineral

Minutes

In this Issue:

The Prez Says...	Page 1
June Program – “Maryland Minerals: A Bit of the Unusual, Extreme, and Spectacular ”	Page 1
Minutes of the May Business Meeting	Page 3
May 2017 Program “Geology of the National Capital Region”	Page 3
'Nesting doll' minerals offer clues to Earth's mantle dynamics	Page 5
Volcanic Arcs Form by Deep Melting of Rock Mixtures	Page 6
Researchers Shed New Light on Earth's Mineral Kingdom	Page 7
Get it While You Can: the Milpillaz Azurite Story	Page 8
Mineral of the Month - Pyrite	Page 10
Geologist of the Month – René Just Haüy	Page 11
Mineralogical Society of America Editors' Picks	Page 12
Upcoming Geology Events	Page 13
Useful Mineral Links	Page 13
AFMS Code of Ethics	Page 14

Volume 75-06

June 2017

Prez Says...

by Dave
Nanney,
MSDC President

Spring is almost gone in our garden. We

have a large number of individual plants which are late bloomers. Individually, they are some of the most beautiful plants in our collection, but there is nothing that beats the mass blooms early in the season. All of the rain is yielding significant new growth on the plants, but also on the weeds. We are now moving into the planting season, as we have several hundred new plants in holding beds, looking for homes in the garden. My back is extremely aware of its limitations, while my bride, not so aware....

We did take time to visit the mineral show in Towson. It's smaller than many, but had several dealers with attractive stuff. We only walked away with three new additions, including another of the grape agates from Indonesia. We got one when we were in Tucson, for a significantly higher price, and a marginally deeper purple color. The mineral dealer Al Pribula picked up several in Tucson and was offering them at extremely reasonable prices. Our two newest members, Amanda and Steve Parker, were there as well and definitely enjoyed the show. I saw one box of treasures which were extremely nice with another “in the car”. The Parkers have taken the collecting experience to a whole new level. They also brought us several large calcites from their Pennsylvania quarry visit for our mineral walk. We have a single path lined with “yard rocks” from several estate sales. They aren't of display quality, yet have enough interesting minerals to suggest a day in the garden to look at mineral is in our near future.

I really want to express once again, my



June Program

“Maryland Minerals: A Bit of the Unusual, Extreme, and Spectacular”

Presented by Jake Slagle

by Dave Hennessey

When searching the internet for information about local (e.g. Virginia, Maryland, Pennsylvania) minerals, localities or collectors, I often find relevant links that lead me to the same site – the Mineral Bliss blog. It seems that whatever has piqued my interest already piqued the interest of veteran mineral collector, Jake Slagle. Not only that - he has researched the topic and written an article about it. Jake's blog articles are always fact filled, but more than that, they relate interesting personal anecdotes and include pictures that bring an extra dimension to the stories Jake tells. Jake describes himself as a “collector of, writer about, and photographer of minerals.” His blog brings together all those facets of his enthusiasm for and dedication to our shared hobby.

I am happy to report that for our June 7th program, Jake has agreed to make a presentation to the club on Maryland Minerals. His presentation will be a tour of unusual, extreme, and spectacular Maryland minerals and will include information especially relevant to MSDC regarding the major role members played in 1944 and



again in 1965 with respect to phosphate concretions found on the grounds of NASA Goddard's Visitor Center in Greenbelt, Maryland.

A life-long Maryland resident, Jake specializes in Maryland and regionally collected mineral, micromounts, and rare species. Like many of us, Jake enjoyed mineral collecting as a child but then took a hiatus (of 45 years) before reconnecting with the hobby in the late 1990's. He created the Maryland Minerals website in 2007 and the Mineral Bliss blog in 2009, and continues to manage both today. He has consulted at the Harvard Mineralogical Museum regarding its Maryland collected minerals. Jake was Program Director for the Baltimore Mineral Society from 2007 through 2016 and has been the Secretary of the Baltimore Mineral Society from 2011 through the present.

Please join us in taking Jake to dinner on June 7th 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 and head up to the Cathy Kerby Room for Jake's presentation.

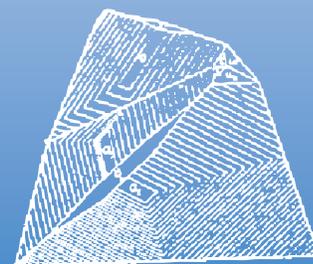
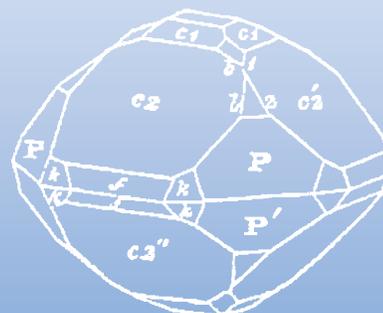
and our collective appreciation to the Fishers for continuing to support our need for a projector at our monthly meetings. Not having a capability for over a year at the Smithsonian has caused them a lot of personal inconvenience, and I can only say thank you.

I also want to compliment our Vice President, Dave Hennessey, for the excellent programs he has provided us. Steve Johnson continues to provide us with a quality newsletter worth taking time to read in detail. Our club is a product of its members, and we certainly have a large number of super friends.

See you on June 7 to listen to Jake Slagle, editor of the Mineral Blog - "Mineral Bliss".

Geological and Mineralogical Terms

Craton	Cratons are the stable portions of the continental crust distinct from regions that are more geologically active and unstable. Cratons can be described as shields, in which the basement rock crops out at the surface, and platforms, in which the basement is overlaid by sediments and sedimentary rock.
Cleavage	The tendency of a mineral to break along flat planar surfaces as determined by the structure of its crystal lattice. These two-dimensional surfaces are known as cleavage planes and are caused by the alignment of weaker bonds between atoms in the crystal lattice. Cleavage planes are distinguished from fracture by being smooth and often having reflective surfaces.
Fracture	The way a mineral breaks other than along a cleavage plane. Fracture Terms: Conchoidal - Fracture surface is a smooth curve, bowl-shaped (common in glass); Hackly - Fracture surface has sharp, jagged edges; Uneven - Fracture surface is rough and irregular; Fibrous - Fracture surface shows fibres or splinters.
Metamict	A minerals that loses its crystal structure due to decay of the radioactive elements within it.
Allochthonous	Either fossils, sediments, or rocks that were formed elsewhere and later transported into the location where they are presently found. An example is an Allochthon, which is a large block of rock which has been moved from its original site of formation, usually by low angle thrust faulting.
Amygdaloidal	Amygdules or amygdales form when the gas bubbles or vesicles in volcanic lava (or other extrusive igneous rocks) are infilled with a secondary mineral such as calcite, quartz, chlorite or one of the zeolites. Rocks containing amygdules can be described as amygdaloidal.
Ultramafic	Almost feldspar free. Ultrabasic. [dunite, peridotite, pyroxenite]
Graywacke	Variety of sandstone generally characterized by its hardness, dark color, and poorly-sorted, angular grains of quartz, feldspar, and small rock fragments (lithic fragments) set in a compact, clay-fine matrix. From German Grauwacke.]
Eustatic movements	Changes of sea level, constant over wide areas, due to alterations in the volume of the oceans resulting from formation or melting of ice caps



Editor's Note: Crystal Shapes are from Goldschmidt's "Atlas der Krystallformen"

CLUB INFO

MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA

MEETINGS

Meetings are the First Wednesday of the Month (Jan-Jun and Sep-Dec). We meet in the lobby of the Smithsonian National Museum of Natural History at 7:45pm.

WEBSITE

<http://mineralogicalsocietyofdc.org/>

FACEBOOK

www.facebook.com/MineralogicalSocietyOfTheDistrictOfColumbia

2017 Officers & Directors

President	Dave Nanney, dnanney@cox.net
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Webmaster	Casper Voogt

May Business Meeting Synopsis

By Andy Thompson, Secretary

President Dave Nanney called the May meeting to order and welcomed visitors, friends and members, including returning Steve and Amanda, Cindy, Dave and Donna. Treasurer John Weidner reported that the club continues to enjoy fiscal solvency and an expanding membership. Bob Cooke described the upcoming Northern Va club's monthly meeting, held on the 4th Monday. Their presentation will be given by Casper Voogt (one of our webmasters) who will share his discoveries from when he went on the Mindat field trip to Myanmar, formerly known as Burma. Members approved the minutes of the April Business meeting as published in the May newsletter.

There were no outstanding Old Business items discussed. But by way of New Business, a proposal was made that MSDC consider including in its 75th anniversary celebration some form of joint activity with the Micromounters of the Capital Area who are celebrating their 50th anniversary. Dave welcomed Kathy's proposal and noted that this item will be on the agenda for the next MSDC board members' meeting whose date is TBA.

A motion to close the business meeting was made, seconded and unanimously approved. President Nanney then turned the spotlight on V.P. Dave Hennessey who introduced the evening's speaker, Scott Southworth, of the USGS.

"Geology of the National Capital Region" Presented by Scott Southworth, USGS

By Andy Thompson, Secretary



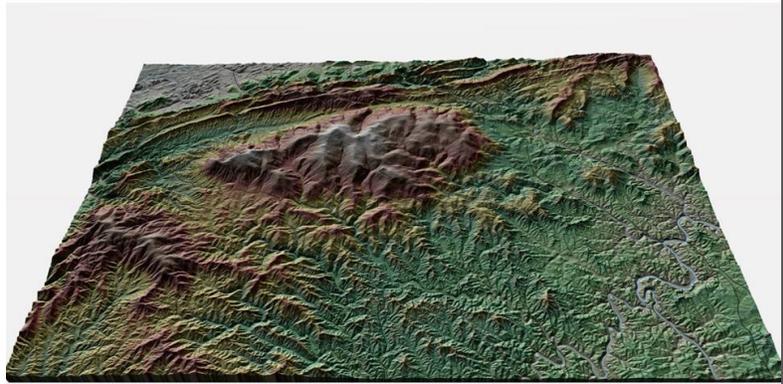
Scott Southworth, a 37 year veteran geologist with the United States Geological Survey (USGS), presented "The Geology of the National Capital Region: Virginia, DC and Maryland." Scott said that although he had spoken previously to MSDC and at many scientific conferences, for this evening's talk he had thrown away the earlier scripts and decided to share some insights never before discussed with MSDC. He joked that his talk could have as a subtitle: "Thirty Seven Years of Weird Things". In particular, his and others' findings have raised several quandaries for which he has found no satisfactory answers.

His presentation focused on the millennia of geological processes which have shaped and reshaped the bedrock and landscape of today's DC area. Central among those has been the eroding action caused by the Potomac River. Those constant and continuing geological developments have shaped and reshaped the bedrock and land scape. Those changes, Scott said, were similar to the unending series of passing clouds. He noted this

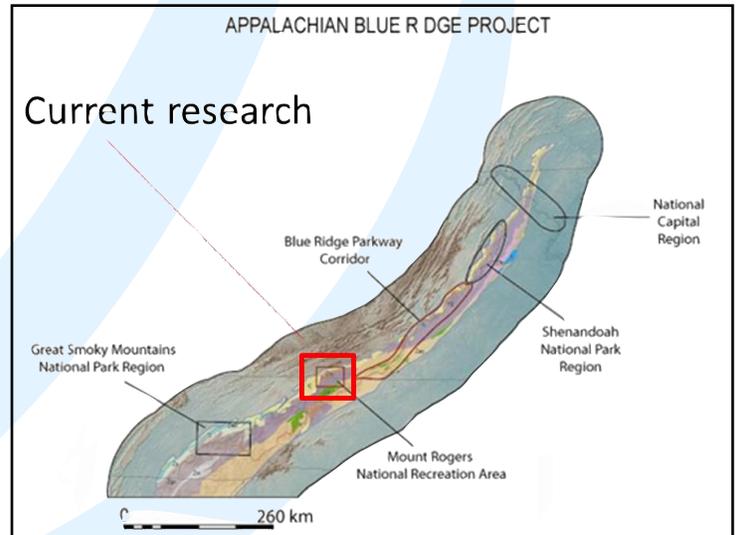
metaphor applies to the entire planet: "Continents and oceans are as transient as clouds."

Scott explained that the first scientific attempt to map the national capital region local to DC began in 1901. Scientists to this day struggle to understand the sequence of events and processes which have brought the land scape to its current setting. During the latter part of the 20th century, that mapping effort incorporated plate tectonic theory as well as several newly available technologies. LIDAR, for example, uses laser light pulses and the return time to their source, to measure exact distances and heights, that is, the ranges, of geological surface features. So "LIDAR" is an acronym for Light Detection And Ranging. Geologists then use those exact measurements to create Digital Elevation Models, DEMs, which are 3D representation of the heights of topological features, such as mountains and valleys symbolized by colors. Those technologies made possible a portrait of geologic local features as well as for the entire US, all the earth's continents and beyond to the surface features of other planets.

Geology of the Mount Rogers Area, VA-NC-TN



One broad context for this geologic mapping research firmed up in 1962 when the USGS-sponsored the Appalachian Blue Ridge Project (ABRP) which focuses on 5 areas and ranges from the Great Smoky Mountains National Park Region in the south, to the National Capital Region in the north.(see slide 1 below).

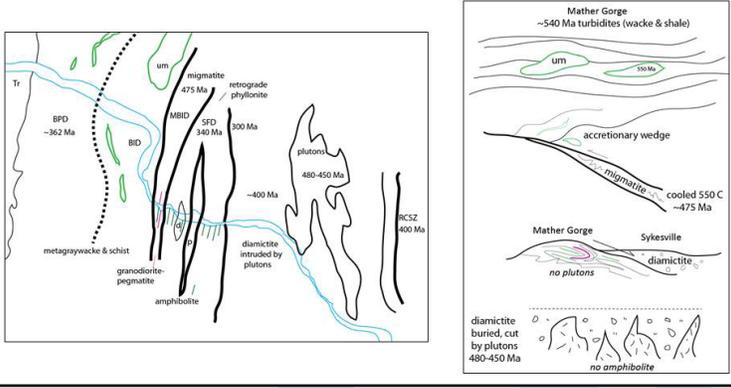


As illustrated above, the Project began with the southern-most region, Mount Rogers, and asked: How do these Blue Ridge rocks compare with other rocks along the Appalachian formation extending up into Pennsylvania, New York, and beyond to the north eastern states?

The subject of Scott's presentation, a geological portrait of the Potomac River basin on the boundary of the Piedmont and Coastal

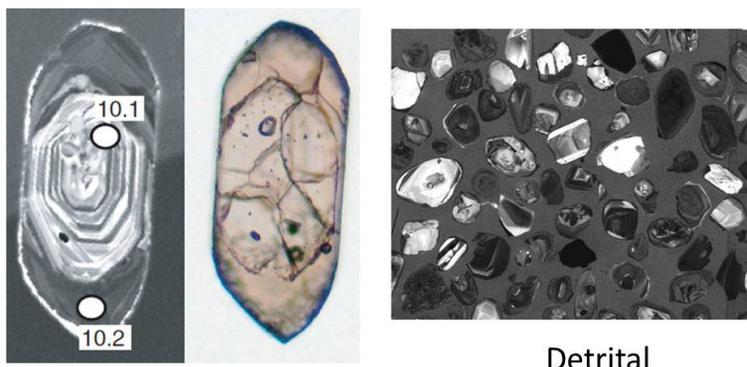
Plain, continues to be subject to additional research finding. One portrait below, on the left shows the time frame for when metagraywacke, pegmatite and amphibolite depositions arrived millions of years ago. The right hand illustration shows how the sections of the Mather Gorge's migmatite cooled and diamicnite deposits were sectioned off by pluton deposits.

The resulting geologic map improves our understanding of how the world was made



Current portraits are generated by petrology and geochronology. These analyses attempt to answer the question: what and when did these rocks get to where they are today? One ground-breaking tool has been the analysis of tiny zircons which allows for an accurate dating of the crystals, including different ages for different parts of zircon crystals. In brief, when the zircons form, they typically incorporate uranium but no lead. So millions of years later, any lead found within the crystal got there by the radioactive decay of the uranium atoms, including lighter 235 and heavier 238 uranium atoms. Each has a well-known and established decay rate. Therefore measurement of the ratio of uranium to lead, for both types of uranium, gives two tests to determine the age of the zircons. Sometimes, the discovery of fossils such as trilobites can also provide dates for the rock formations.

TECHNIQUES



Igneous

U-Pb zircons

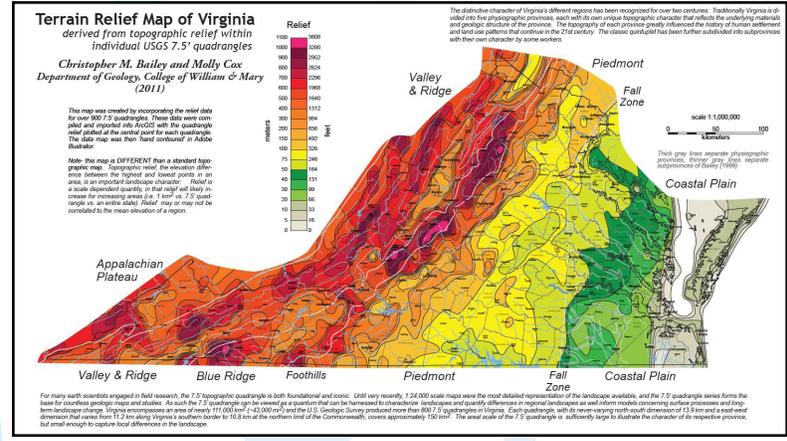
Detrital



Despite this accuracy for dating when a formation was deposited, there are many "weird" puzzles or ambiguities which remain unresolved. For example, in the Dumfries, Virginia area along I-95 and just west of the Potomac River, why is there faulting and what caused it? Did it have to do with an impact crater that shaped the geology along the I-95 corridor? Did tectonic forces contribute to that faulting or was it due to loading during the Miocene? Why did so much sediment arrive about 17 million years ago? Perhaps the most weird puzzle, Scott suggested, was what

caused the change in the route of the ancestral Potomac River and relocated it to where we find it flowing today? Resolution of such questions requires more evidence than is currently available.

This synopsis of Scott's presentation, with his deep time perspective and 206 power point slides, only hint at the comprehensive analyses he shared with attendees. Perhaps one way to conclude this synopsis is the 2011 USGS Terrain Relief map of Virginia (below), color coded for heights, which Scott used to illustrate the five physiographic provinces geologists have relied on for the past 200 years. That map, below, shows the downward slope from the westward mountains to the Atlantic Ocean. The map color variations hint at the complex nature of the geological analysis yet clearly shows the focus of his presentation, the National Capital area, as directly on the boundary between the Piedmont to the west and the Coastal Plain province to the east. That boundary is demarcated by the Potomac River which, in different places over its millions of years of cutting through the rock, has carved out diverse rock formations, large pot holes, and today currently covers and cloaks undiscovered rock accumulations settled in the bottom of the river's gorges and incisions.

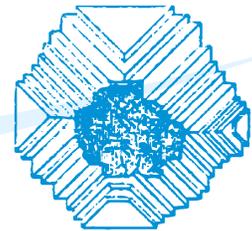


Scott referred to one final example which illustrates the many geological puzzles yet to be resolved. In August of 2011, the National Capital area was rocked by an earthquake whose epicenter was located at a considerable distance in the central Virginia seismic zone (Louisa County in the vicinity of Mineral, Va). Given the current understanding of the geology of the areas, why that quake shook the DC area is another of the many puzzles yet to be solved.

Scott encouraged attendees to continue to explore these puzzling questions by personally traveling and studying the features along Corridor H in West Virginia, a recent highway construction which has unearthed many deep time geological features. That suggestion rang a bell with many attendees who had recently spent a very full day doing exactly that and collecting rock samples along the way.

When Scott concluded his presentation, he was loudly applauded for sharing his well-seasoned perspective. He fielded a few additional questions and then President Dave Nanney thanked Scott for sharing such a treasured and richly illustrated vision.

The evening concluded with members sharing some of their 'show and tell' rocks, including a beautiful green fluorite from Durham England, and samples from the Rogerly Mine.



'Nesting doll' minerals offer clues to Earth's mantle dynamics

from GeologyIn.Com



The fragment of the metamorphic rock eclogite in which the garnet that encased the ferric-iron-rich majorite sample was found in Northern China.

Rare sample discovered of the mineral majorite $Mg_3(MgSi)(SiO_4)_3$ that originated at least 235 miles below Earth's surface

Recovered minerals that originated in the deep mantle can give scientists a rare glimpse into the dynamic processes occurring deep inside of Earth and into the history of the planet's mantle layer. A team led by Yingwei Fei, a Carnegie experimental petrologist, and Cheng Xu, a field geologist from Peking University, has discovered that a rare sample of the mineral majorite originated at least 235 miles below Earth's surface. Their findings are published by Science Advances.

Majorite is a type of garnet formed only at depths greater than 100 miles. Fascinatingly, the majorite sample Fei's team found in Northern China was encased inside a regular garnet -- like mineralogical nesting dolls. It was brought to surface as an eclogite xenolith in the North China Craton, one of the oldest cratonic blocks in the world. What's more, the

majorite was rich in ferric iron, an oxidized form of iron, which is highly unusual for the mineral.

All of these uncommon factors prompted the team to investigate the majorite's origins.

They used several different kinds of analytical techniques to determine the chemistry and structural characteristics of this majorite formed deep inside Earth. In order to determine the exact depth of its origin, Carnegie's postdoc Renbiao Tao conducted high-pressure experiments that mimicked the formation conditions of natural majorite. The team pinpointed its origin to a depth of nearly 250 miles (400 kilometers), at the bottom of the soft part of the upper mantle, called the asthenosphere, which drives plate tectonics.

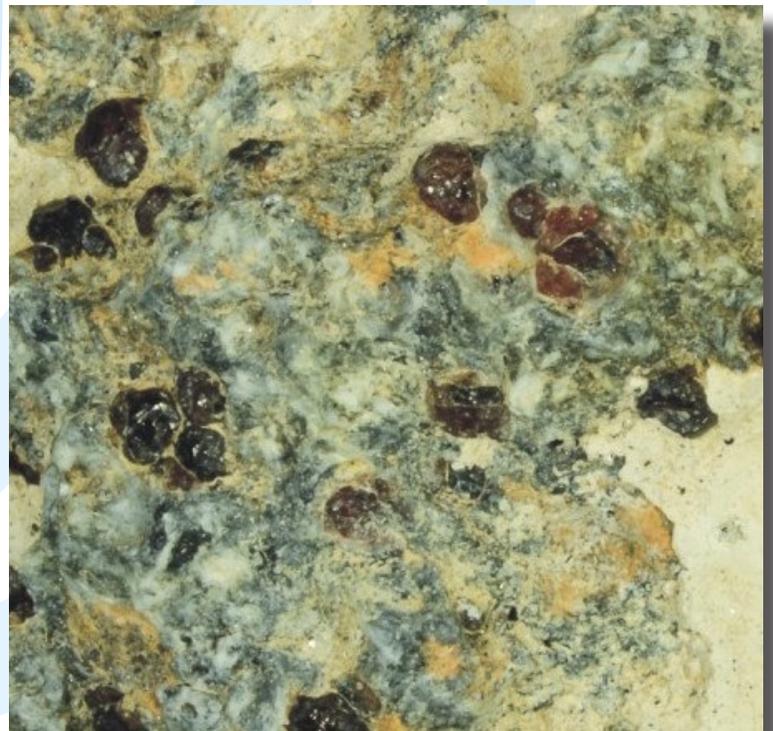
It is extremely unusual that a high-pressure majorite could survive transportation from such a depth. Adding to the strange circumstances is the fact that it was later encased by a garnet that formed at a much shallower depth of about 125 miles (200 kilometers). The nesting-doll sample's existence required two separate geological events to explain, and these events created a time capsule that the researchers could use to better understand Earth's deep history.

"This two-stage formation process offers us important clues about the mantle's evolutionary stage at the time when the majorite was first formed," Fei explained.

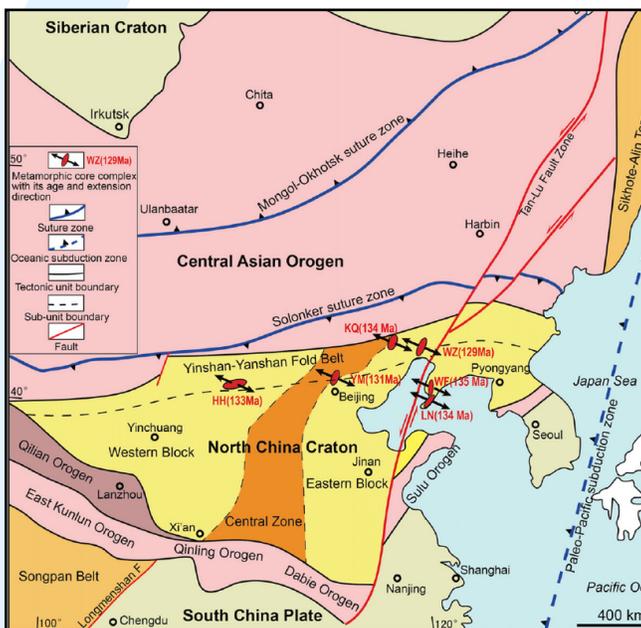
The sample's location and depth of origin indicate that it is a relic from the end of an era of supercontinent assembly that took place about 1.8 billion years ago. Called Columbia, the supercontinent's formation built mountain ranges that persist today.

"More research is needed to understand how the majorite became so oxidized, or rich in ferric iron, and what this information can tell us about mantle chemistry. We are going back to the site this summer to dig deeper trenches and hope to find fresh rocks that contain more clues to the deep mantle," Fei added.

The above post is reprinted from *Materials* provided by Carnegie Institution for Science.



The fragment of the metamorphic rock eclogite in which the garnet that encased the ferric-iron-rich majorite sample was found in Northern China. Image is courtesy of Yingwei Fei.



From: ResearchGate.Net

Volcanic Arcs Form by Deep Melting of Rock Mixtures

from GeologyIn.Com

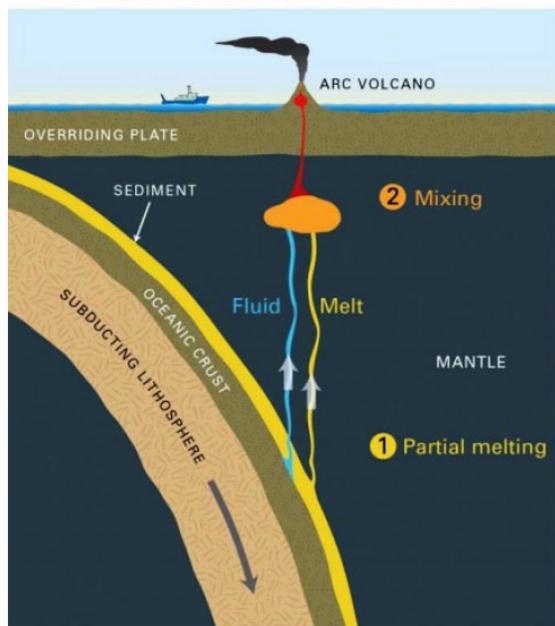
Beneath the ocean, massive tectonic plates collide and grind against one another, which drives one below the other. This powerful collision, called subduction, is responsible for forming volcanic arcs that are home to some of Earth's most dramatic geological events, such as explosive volcanic eruptions and mega earthquakes.

A new study published in the journal *Science Advances*

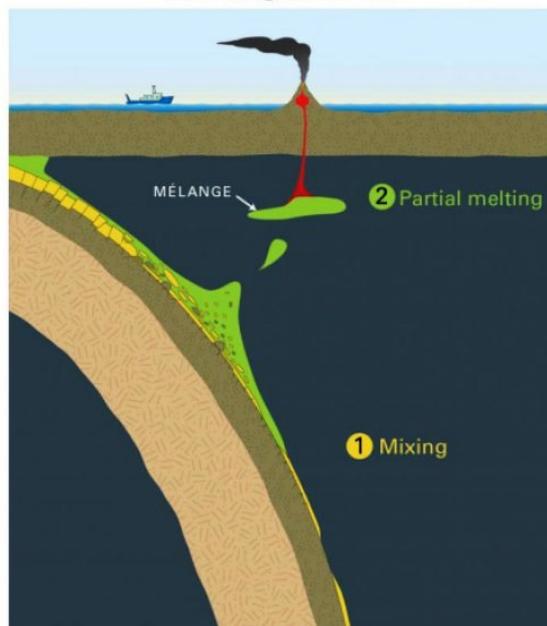
Frankfurt, Germany. Based on field observations of *mélange* outcrops, Marschall noted that blobs of low-density *mélange* material, called diapirs, might rise slowly from the surface of the subducting slab and carry the well-mixed materials into the mantle beneath arc volcanoes.

"The *mélange*-diapir model was inspired by computer models and by detailed field work in various parts of the world where rocks that come from the deep slab-mantle interface have been brought to the surface by tectonic forces," Marschall says. "We have been discussing the model for at least five years now, but many scientists thought the *mélange* rocks played no role in the generation of magmas. They dismissed the model as 'geofantasy.'"

Fluid/sediment melt model



Mélange model



It was long-thought that fluids from a subducted tectonic plate and melted sediments percolated into the mantle where they mixed, triggering more melting, and eventually erupt at the surface (left). Mixing and melting are reversed in the *mélange* model (right). Credit: Jack Cook, Woods Hole Oceanographic Institution

In their new work, Nielsen and Marschall compared mixing ratios from both models with chemical and isotopic data from published studies of eight globally representative volcanic arcs: Marianas, Tonga, Lesser Antilles, Aleutians, Ryukyu, Scotia, Kurile, and Sunda. "Our broad-scale analysis shows that the *mélange* mixing model fits the literature data almost perfectly in every arc worldwide, while the prevailing

changes our understanding of how volcanic arc lavas are formed, and may have implications for the study of earthquakes and the risks of volcanic eruption. Researchers led by the Woods Hole Oceanographic Institution (WHOI) have discovered a previously unknown process involving the melting of intensely-mixed metamorphic rocks -- known as *mélange* rocks -- that form through high stress during subduction at the slab-mantle boundary.

Until now, it was long-thought that lava formation began with a combination of fluids from a subducted tectonic plate, or slab, and melted sediments that would then percolate into the mantle. Once in the mantle, they would mix and trigger more melting, and eventually erupt at the surface. "Our study clearly shows that the prevailing fluid/sediment melt model cannot be correct," says Sune Nielsen, a WHOI geologist and lead author of the paper. "This is significant because nearly all interpretations of geochemical and geophysical data on subduction zones for the past two decades are based on that model."

Instead, what Nielsen and his colleague found was that *mélange* is actually already present at the top of the slab before mixing with the mantle takes place. "This study shows -- for the first time -- that *mélange* melting is the main driver of how the slab and mantle interact," says Nielsen.

This is an important distinction because scientists use measurements of isotope and trace elements to determine compositions of arc lavas and better understand this critical region of subduction zones. When and where the mixing, melting, and redistribution of trace elements occurs generates vastly different isotopic signature ratios.

The study builds on a previous paper by Nielsen's colleague and co-author Horst Marschall of the Goethe University in

sediment melt/fluid mixing lines plot far from the actual data," Nielsen says.

Understanding the processes that occur at subduction zones is important for many reasons. Often referred to as the planet's engine, subduction zones are the main areas where water and carbon dioxide contained within old seafloor are recycled back into the deep Earth, playing critical roles in the control of long-term climate and the evolution of the planet's heat budget.

These complex processes occur on scales of tens to thousands of kilometers over months to hundreds of millions of years, but can generate catastrophic earthquakes and deadly tsunamis that can occur in seconds.

"A large fraction of Earth's volcanic and earthquake hazards are associated with subduction zones, and some of those zones are located near where hundreds of millions of people live, such as in Indonesia," Nielsen says. "Understanding the reasons for why and where earthquakes occur, depends on knowing or understanding what type of material is actually present down there and what processes take place."

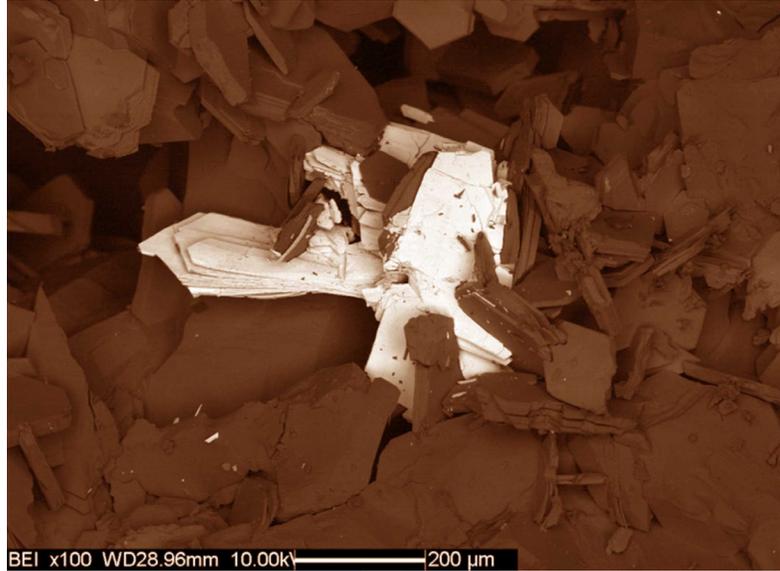
The research team says the study's findings call for a reevaluation of previously published data and a revision of concepts relating to subduction zone processes. Because *mélange* rocks have largely been ignored, there is almost nothing known about their physical properties or the range of temperatures and pressures they melt at. Future studies to quantify these parameters stand to provide even greater insight into the role of *mélange* in subduction zones and the control it exerts over earthquake generation and subduction zone volcanism.

The above post is reprinted from Materials provided by Woods Hole Oceanographic Institution.

Researchers Shed New Light on Earth's Mineral Kingdom

by NewsStaff at Sci-News.Com

As of January 31, 2016, the International Mineralogical Association has approved 5,090 mineral species, fewer than 100 of which make up 99 percent of Earth's crust. Of those 5,090, around 2,550 are defined as rare — found at five or fewer locations worldwide.



This false-color image shows the mineral ichnusaite. Image credit: American Mineralogist / Paulo Biagioni et al.

“And more than two-thirds of known mineral species, including the great majority of rare species, have been attributed to biological changes in Earth's near-surface environment,” said team member Dr. Robert Hazen, of the Carnegie Institution.

According to Dr. Hazen and his colleague, Dr. Jesse Ausubel from the Rockefeller University, each rare mineral fits into one or more of four categories:

(i) Unique conditions: “In very simple terms, imagine making minerals at a kitchen stove using a pressure cooker. What results in the pot is a function of variables: temperature, pressure and the ingredients,” said Dr. Hazen, who is the lead author of a paper published online in the journal *American Mineralogist*. “Some minerals are rare because, even though they form from the commonest of ingredients, they must be cooked at exquisitely controlled conditions.

“For example, the mineral hatrurite (Ca_3SiO_5) is formed from three of Earth's most abundant elements—calcium, silicon, and oxygen. But this mineral forms only in a very restricted environment with temperatures above 1250 degrees Celsius and in the absence of another extremely common element, aluminum.”

(ii) Planetary Constraints: “Incorporation of rare elements, or mineral formation at pressure-temperature conditions rarely encountered in near-surface environments,” the scientists said. “Other minerals are extremely rare because their ingredients are almost never found concentrated in Earth's crust. Thus, such scarce chemical elements as beryllium, hafnium and tellurium form relatively few minerals and most species are rare.”

(iii) Ephemeral Conditions: Some minerals form under unusual conditions, but then simply melt, evaporate or dehydrate when exposed to different surface conditions. A crystalline form of methane hydrate, for example, found in core samples

from continental shelf and Arctic drill sites, evaporates at room pressure. “As well, water-soluble minerals may also be under-reported, and thus appear to be rare,” the researchers said.

“More than 100 mineral species can persist in dry environments for many years, only to be washed away during rare rain events.”

Among the least stable are rare mineral species that adsorb moisture from the air then dissolve in it. And a few, like edoylerite, metasideronatrite and sideronatrite gradually decompose on exposure to sunlight.

(iv) Rarely sampled sites: In this category are rare minerals that simply come from under-sampled regions, from extreme environments such as the flanks of erupting volcanoes, frigid and remote regions of Antarctica, or the deepest reaches of the oceans. Other minerals that may be much more common than are represented in mineral museums include a host of species that are difficult to recognize based on their lack of bright colors or showy crystal faces. Most mineral collectors favor eye-popping specimens for their display case.

“Most mineral experts are familiar with at best a handful of the 2,550 obscure rarities,” said Dr. Hazen, citing the mineral fingerite ($\text{Cu}_{11}\text{O}_2(\text{VO}_4)_6$) from El Salvador as ‘a perfect storm of rarity.’

“Fingerite forms under extremely restrictive conditions, from rare elements, it is water soluble and disappears when rained upon, and it comes from dangerous volcanic fumaroles near active volcanoes, so is rarely collected,” he said. “Consequently, fingerite is only known from near the summit of the Izalco Volcano in El Salvador.”

According to Dr. Hazen, a mineral called ichnusaite ($\text{Th}(\text{MoO}_4)_2 \cdot 3\text{H}_2\text{O}$) is another true rarity — created through a subterranean mash-up of the radioactive element thorium and lead-like molybdenum, with only one specimen ever found, in Sardinia a few years ago.

“If you wanted to give your fiancé a really rare ring, forget diamond. Give her Sardinian ichnusaite,” he said.

Robert M. Hazen & Jesse H. Ausubel. 2016. On the Nature and Significance of Rarity in Mineralogy. *American Mineralogist*, vol. 101, doi: 10.2138/am-2016-5601CCBY



Fingerite from Izalco Volcano, Sonsonate Department, El Salvador. Photo: Brent Thorne. From Mindat

Get it While You Can: the Milpillas Azurite Story

by Bob Carnein

(Originally published in the Colorado Chapter of the Friends of Mineralogy Newsletter). Found by the editor in the Spring 2016 edition of the Friends of Mineralogy Newsletter.)

A Lake George Club member recently asked me why I had paid what she thought was an exorbitant amount of money for an azurite specimen from Mexico (Figures 2, 3). The price was in the very low 3-figures, which is about as far as my budget goes for mineral specimens. I bought the specimen from a Mexican dealer at the Lake George Show last year. This article will attempt to answer that question and show you why the Milpillas mine is one of the great contemporary mineral localities. It's also a warning that, like most such deposits, this one won't last forever as a source of wonderful minerals.

Many of the minerals that collectors love most are weathering products of hydrothermal sulfide deposits. These form when heated aqueous solutions carrying metal ions move upward and outward from crystallizing magma or other sources. As these solutions cool or interact with groundwater, they deposit their metals, often in combination with sulfur. Common metallic sulfide minerals include pyrite (FeS_2), chalcopyrite (CuFeS_2), galena (PbS), and sphalerite (ZnS). Such deposits are said to be hypogene, meaning they formed from ascending hydrothermal solutions.

noticed than the drab hypogene minerals they're often derived from.



Fig. 2, 3: Two Milpillas azurite specimen (8 cm across; 4 cm tall). (Carnein collection and photos)

If some of the metal ions of a weathering hydrothermal deposit are carried below the water table, where there isn't any oxygen available, they re-precipitate as secondary sulfide minerals in whatever space is available. For example, chalcocite (Cu_2S) often forms an enriched "blanket" just below the water table in copper deposits. These supergene sulfides supplement the hypogene sulfides of the unaltered original deposit, forming a zone of supergene sulfide enrichment.

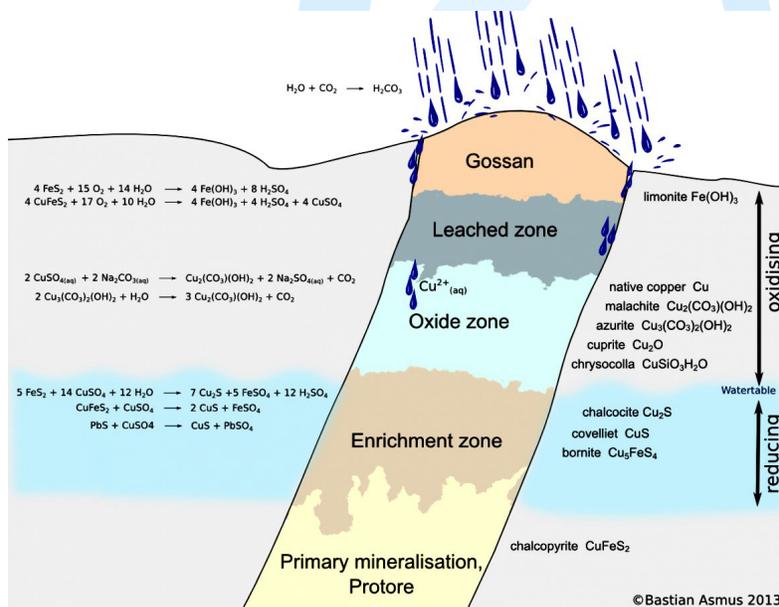


Figure 1: Supergene enrichment of a primary copper (chalcopyrite) ore. (en.acheometalurgie.de)

Hypogene sulfide deposits are hard to find unless uplift, weathering, and erosion have exposed them at the surface. When exposed to air, organic activity, and water percolating downward from rain and snow melt, sulfide minerals begin to break down (see Figure 1). Ubiquitous pyrite speeds up the process. When pyrite weathers, it releases sulfuric acid, which attacks the associated relatively stable sulfides, such as chalcopyrite, sphalerite, and galena. These acid solutions descend from the surface, redepositing and concentrating the metals in secondary (supergene) deposits.

Supergene deposits are of 2 basic types. If the metals are redeposited above the water table, they combine with oxygen and other ions to form oxidized minerals. These include oxides, such as cuprite (CuO), as well as carbonates, sulfates, and a host of other "ates", depending on what's available. These oxidized minerals are often colorful and attract attention—they are more likely to be



Figs. 4, 5: Two specimens of malachite replacing azurite from Milpillas (3 cm tall; 6 cm across). (Carnein collection and photos)

The combined supergene oxidized zone and the zone of supergene sulfide enrichment are the "icing on the cake" of many hydrothermal deposits. They're relatively close to the surface and relatively rich, making them cheap to exploit. They commonly pay for all of the infrastructure required for a mining company to process the deeper, lower grade hypogene ore, once the supergene mineralization runs out.

Certain minerals of the oxidized zone are universally coveted by collectors. If we focus on copper deposits, the most familiar ones are azurite, malachite, chrysocolla, cuprite, and a host of other colorful secondary minerals. Unfortunately, secondary copper minerals rarely occur



Fig. 7: Brochantite crystals from Milpillas. (4 cm across)(Carnein collection and photo)

as good specimens in Colorado. If you want to add a great specimen of azurite to your collection, you will have to buy it.

At one time, thousands of world-class azurites came from the Bisbee district and other localities in Arizona, where the arid climate favors development of especially thick and deep oxidized deposits. When I was a kid, such specimens could be picked up at reasonable prices at shows and from mail-order dealers. But fine Bisbee (or Carlota, Morenci, or Ajo) azurites have disappeared into old collections or museums, with top quality “recycled” material commanding prices in the thousands, tens of thousands, or hundreds of thousands of dollars. The same is now true of superb azurites from Namibia (Tsumeb) and France (Chessy).

A few localities currently produce fine azurite. Specimens can be found from Morocco, China, and Laos, but these seldom compare favorably with the old time Arizona or Tsumeb material. However, one contemporary source produces truly superb azurites as well as other secondary copper minerals, at prices that are within the budgets of many collectors. This is the Milpillas mine in Sonora, Mexico.

The Milpillas mine, opened in 2006, is located in northern Sonora, about 60 km. southwest of Bisbee, AZ (Fig. 6). The miners’ village of Cuitaca, about 17 km. to the south, is the nearest settlement (Moore and Origlieri, 2008).



Figure 6. Location map (Moore and Origlieri, 2008).

Milpillas is one of more than 50 major porphyry copper/molybdenum/gold/silver deposits of the southwestern U.S. and northern Mexico. (Porphyry deposits form underneath volcanoes, where porphyritic host rocks are fractured and shot full of low grade hydrothermal veinlets.) It has no surface expression and was found by mistake as a result of U.S. Geological Survey sampling in 1975. Sediment samples indicating a buried porphyry-copper deposit were actually transported in from elsewhere, but they inspired a Cyprus-AMAX subsidiary to conduct test drilling. This and later drilling by Grupo Peñoles and associates defined a high grade oxidized deposit with azurite, malachite, and other copper minerals under 300 to 500 m. of gravel and alluvium. The oxidized ores overlie lower grade secondary sulfide deposits consisting of chalcocite and minor covellite. Supergene ores typically range between 1% and 10% copper (Moore and Origlieri, 2008) at depths of 150 to 750 m. Lower grade hypogene ore occurs below.

Unlike most porphyry copper deposits, Milpillas is exploited by underground mining. Large trucks bring the ore to the surface, where it is crushed to pieces averaging 2 cm. across. Crushed ore is piled in leach heaps (much like the ones at Cripple Creek), where it is bathed in acid. The leachate then passes through tanks

containing stainless-steel cathodes, where copper is deposited electrolytically. Copper is then stripped from the cathodes and shipped to customers. The high tech processing plant is designed to produce 65,000 tons of cathode copper per year. None of this favors specimen production. Reserves should last until about 2025.



Figs. 8, 9: Pyrite crystal (3 cm tall) coated by bornite; barite crystals on dickite (4 cm across), Milpillas mine. (Carnein collection and photos)

Like most mining companies, Grupo Peñoles strongly discourages mineral collecting. This, combined with illicit drug operations in the area, has made it difficult for miners and dealers to recover specimens (though some drug dealers apparently accept mineral specimens in lieu of cash). Despite this, a steady supply of fine material has made its way northward since 2006. Periodically, dealers claim that mining of oxidized ores is finished, only to be followed by new finds of mind-boggling azurite, malachite, brochantite, and other minerals. However, once mining works its way downward into the secondary sulfide (chalcocite) blanket, the colorful specimens now available will disappear from the market. The supply is already decreasing, and smart collectors will buy good pieces while they are still available at bargain prices.

Reference Cited:

- Moore, T.P., and M.J. Origlieri, 2008, Famous Mineral Localities: the Milpillas mine, Cananea district, Sonora,
- Mexico: The Mineralogical Record, vol. 39, no. 6, p. 25-34.

You can also find this article online in the Lake George Gem and Mineral Club’s March 2016 newsletter, at <http://www.lggmclub.org/club%20Newsletter.htm>

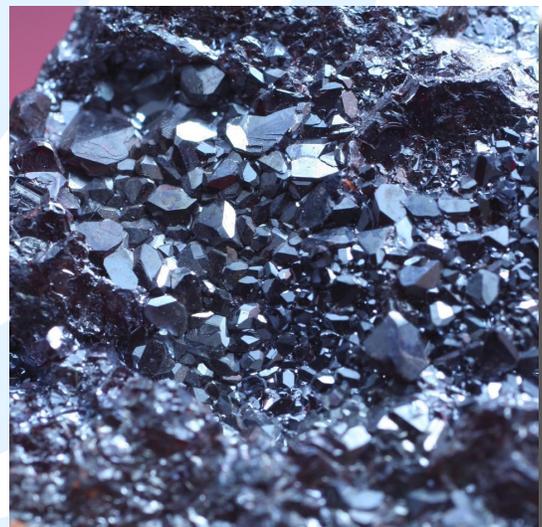


Fig. 10: Cuprite crystals from Milpillas (3 cm across). (Carnein collection and photo)

Mineral of the Month – Pyrite– Edited from Wikipedia, Mindat and Geology.Com

Finally I've run out of the major native elements, so at this point it is time to move on to the next Dana Group - Sulfides. In the new Dana System this has two classes - Sulfides (including Selenides and Tellurides) and Sulfosalts.

The mineral pyrite, also known as fool's gold, is an iron sulfide with the chemical formula FeS_2 and is the most common sulfide mineral. Its metallic luster and pale brass-yellow hue give it a superficial resemblance to gold, hence the well-known nickname of fool's gold. The name "pyrite" is after the Greek "pyr" meaning "fire." This name was given because pyrite can be used to create the sparks needed for starting a fire if it is struck against metal or another hard material. Pieces of pyrite have also been used as a spark-producing material in flintlock firearms. In ancient Roman times, this name was applied to several types of stone that would create sparks when struck against steel; Pliny the Elder described one of them as being brassy, almost certainly a reference to what we now call pyrite. By Georgius Agricola's time, c. 1550, the term had become a generic term for all of the sulfide minerals.

Pyrite is usually found associated with other sulfides or oxides in quartz veins, sedimentary rock, and metamorphic rock, as well as in coal beds and as a replacement mineral in fossils. Despite being nicknamed fool's gold, pyrite is sometimes found in association with small quantities of gold. Gold and arsenic occur as a coupled substitution in the pyrite structure. In the Carlin-type gold deposits, arsenian pyrite contains up to 0.37 wt% gold.

Hand-specimens of pyrite are usually easy to identify. The mineral always has a brass-yellow color, a metallic luster and a high specific gravity. It is harder than other yellow metallic minerals, and its streak is black, usually with a tinge of green. It often occurs in well-formed crystals in the shape of cubes, octahedrons, or pyritohedrons, which often have striated faces.

The only common mineral that has properties similar to pyrite is marcasite, a dimorph of pyrite with the same chemical composition but an orthorhombic crystal structure. Marcasite does not have the same brassy yellow color of pyrite. Instead it is a pale brass color, sometimes with a slight tint of green. Marcasite is more brittle than pyrite and also has a slightly lower specific gravity at 4.8.

Pyrite and gold can easily be distinguished. Gold is very soft and will bend or dent with pin pressure. Pyrite is brittle, and thin pieces will break with pin pressure. Gold leaves a yellow streak, while pyrite's streak is greenish black. Gold also has a much higher specific gravity. A little careful testing will help you avoid the "Fool's Gold" problem.

Even though pyrite is composed of iron and sulfur; the mineral does not serve as an important source of either of these elements. Iron is typically obtained from oxide ores such as hematite and magnetite. These ores occur in much larger accumulations, the iron is easier to extract and the metal is not contaminated with sulfur, which reduces its strength.

Pyrite used to be an important ore for the production of sulfur and sulfuric acid. Today most sulfur is obtained as a byproduct of natural gas and crude oil processing. Some sulfur continues to be produced from pyrite as a byproduct of gold production.

The most important use of pyrite is as an ore of gold. Gold and pyrite form under similar conditions and occur together in the same rocks. In some deposits small amounts of gold occur as inclusions and substitutions within pyrite.

Pyrite has been used as a gemstone. It is fashioned into beads, cut into cabochons, faceted, and carved into shapes. This type of jewelry was popular in the United States and Europe in the mid- to late-1800s.

Most of the jewelry stones were called "marcasite," but they are actually pyrite. Actual marcasite would be a poor choice for jewelry because it quickly oxidizes, and the oxidation products cause damage to anything that they contact. Pyrite itself is not an excellent jewelry stone because it easily tarnishes.

The sulfide minerals (mostly pyrite) in coal and its surrounding rocks can produce acid mine drainage. Before mining, these minerals are deep within the ground and below the water table where they are not subject to oxidation. During and after mining the level of the water table often falls, exposing the sulfides to oxidation. This oxidation produces acid mine drainage which contaminates groundwater and streams. Mining also breaks the rocks above and below the coal. This creates more pathways for the movement of oxygenated waters and exposes more surface area to oxidation. [A good example of this type of contamination is Contrary Creek in Louisa County, Virginia. The environmental damage is the result of local mining \(not coal mining though\).](#)

The conditions of pyrite formation in the sedimentary environment include a supply of iron, a supply of sulfur, and an oxygen-poor environment. This often occurs in association with decaying organic materials. Organic decay consumes oxygen and releases sulfur. For this reason, pyrite commonly and preferentially occurs in dark-colored organic-rich sediments such as coal and black shale. The pyrite often replaces organic materials such as plant debris and shells to create interesting fossils composed of pyrite.



Pyrite cubic crystals on marl from Navajún, La Rioja, Spain (size: 95 by 78 millimetres; main crystal: 31 millimetres (1.2 in) on edge). Photo: Wikipedia

Pyrite	
Category	Sulfides
Formula	FeS_2
Strunz Classification	2.EB.05a
Crystal System	Isometric
Crystal Class	m3 (2/m 3) - Diploidal
Color	Pale brass-yellow
Cleavage	Poor/Indistinct Indistinct on {001}
Fracture	Irregular/Uneven, Conchoidal
Mohs Scale	6-6.5
Luster	Metallic
Tenacity	Brittle
Streak	Greenish-black
Specific Gravity	4.8-5

Mineralogist of the Month - René Just Haüy (1743-1822)

edited from the Wikipedia entry

René Just Haüy (28 February 1743 – 3 June 1822) was a French mineralogist, commonly referred to as the Abbé Haüy after he was made an honorary canon of Notre Dame. He is often referred to as the "Father of Modern Crystallography."

Haüy was born at Saint-Just-en-Chaussée (about 50 miles north of Paris), in the département of Oise. His parents were of a humble rank of life, and were only able to send their son to the College of Navarre and later to the College of Cardinal Lemoine (in Paris) through the kindness and generosity of friends. Haüy became an ordained Roman Catholic Priest. After his ordination, he became one of the teachers at Lemoine. During his leisure hours he began to study botany with special interest in symmetries and shapes found in plants, but a lucky accident changed his interest to another field of the natural sciences. In the house of his friend, M. Defrance, Haüy dropped a group of prismatic crystals of calcite and gathered from the ruin of a fine specimen the cleavage pieces which were recognizable to him as the same form as other crystals of calcite; it appears that through this accident the key to the mystery of the mathematical inter-relationship of these forms was "crystalized" (editor's note: pun intended) for him. Without a mind prepared to interpret this chance occurrence, without the imagination reaching out for an interpretation, the incident would have meant no more to him than to his friend who stood beside him. Haüy's famous exclamation at this moment was "Tout est trouvé" (translation: "All is found" or a more venacular translation would be "All is revealed"). This accident and subsequent experiments resulted in the statement of the geometric law of crystallization associated with his name.

The value of this discovery, the mathematical theory of which is given by Haüy in his *Traité de minéralogie*, was immediately recognized, and when communicated to the Academy, it secured for its author a place in that society. Haüy's name is also known for the observations he made in pyroelectricity.

When the Revolution broke out, Haüy was thrown into prison. He was in danger of losing his life until Étienne Geoffroy Saint-Hilaire interceded on his behalf. In 1802, under Napoleon, he became professor of mineralogy at the National Museum of Natural History and founder of the Musée de Minéralogie. In the same year he was visited by Martin van Marum, at that time curator of both the Teylers Museum and a director of the Hollandsche Maatschappij der Wetenschappen. Van Marum bought a set of pear-wood models from Haüy for the Teylers Museum and in return Haüy became a member of Van Marum's science society. After 1814 he was deprived of his appointments by the Restoration government. His final days were consequently clouded by poverty, but the courage and high moral qualities which had helped him in his youth did not desert him in his old age; he lived cheerful and respected till his death in Paris.

In 1821, he was elected a foreign member of the Royal Swedish

Academy of Sciences. His name is one of the 72 names inscribed on the Eiffel Tower. His brother was Valentin Haüy, the founder of the first school for the blind.

The mineral haüyne, a feldspathoid and member of the sodalite group ($\text{Na}_3\text{Ca}(\text{Si}_3\text{Al}_3\text{O}_{12}(\text{SO}_4))$), was named for Haüy and occurs in silica-deficient igneous rocks in a wide variety of locations.

The following are Haüy's principal works:

- Essai d'une théorie sur la structure des cristaux (1784) via Gallica
- Exposition raisonné de la théorie de l'électricité et du magnétisme, d'après les principes d'Æpinus (1787) BNF
- De la structure considérée comme caractère distinctif des minéraux (1793)
- Exposition abrégé de la théorie de la structure des cristaux (1793) BNF
- Extrait d'un traité élémentaire de minéralogie (1797)
- Traité de minéralogie (5 vols, 1801) BNF: Vol 1 Vol 2 Vol 3 Vol 4 Vol 5
- Traité élémentaire de physique (2 vols 1803, 1806) Google Books
- Tableau comparatif des résultats de la cristallographie, et de l'analyse chimique relativement à la classification des minéraux (1809) BNF
- Traité des pierres précieuses (1817) BNF
- Traité de cristallographie (2 vols, 1822) Google Books

He also contributed papers, of which 100 are enumerated in the Royal Society's catalogue, to various scientific journals, especially the *Journal de physique* and the *Annales du Museum d'Histoire Naturelle*.



Haüyne. Photo: Wikimedia



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 May 2017 issue of the *American Mineralogist*: Journal of Earth and Planetary Materials.

<http://www.minsocam.org>

Anthropogenic Minerals

On page 925 of this issue, Peter Heaney provides a provocative overview of the immensely popular article by Hazen et al. (2017; this volume) regarding minerals that have an anthropogenic parentage. As Heaney notes, textbooks have largely given up on the notion that minerals form only by inorganic processes; he then asks whether we are "prepared to take the next step": to accept synthetic crystals as minerals (as already proposed by Zalasiewicz et al. 2014). Hazen et al. do not require such in their definition of an Anthropocene epoch—they attempt to play by IMA rules. Some of the most intriguing arguments appear to begin with how hypothetical visitors to, or evolved species on, a late Earth might classify crystalline structures. What is technology at present is archeology to a future age. What is uniquely anthropogenic now, may be a primitive step along a biogenic continuum to some future species. As our language evolves over centuries or even decades, it is sure to vary across species and millennia.

Diamondiferous Clues to a Non-chondritic Lower Mantle

On page 927 of this issue, William Bassett reviews a new work by Kaminsky and Lin (2017; this volume) who speculate on the composition of Earth's lower mantle, based on the compositions of minerals included in diamonds and their synthetic analogs as produced in high pressure experiments. In the new work, Kaminsky and Lin (2017) examine the co-existing compositions of ferropericlase and bridgmanite (the latter of which is quenched to an orthopyroxene structure, but is presumed to preserve the composition of the high pressure, proto-mineral phase). They find that in some inclusions, the total amounts of Fe in both phases are high relative to what might be expected had they equilibrated from a pyrolite bulk mantle composition. And yet another set of inclusions contain lower-than-expected Ni. These observations lead Kaminsky and Lin to infer that the lowermost mantle may contain an Fe-rich zone that might even be saturated in a metallic Fe phase that may retain Ni. This suggestion carries with it the implication that mantle plumes from the lowermost mantle should yield volcanic rocks that are enriched in Fe, but depleted in Ni and other siderophile elements.

Defining Chemical Bonds

On page 928 of this issue I. David Brown discusses a new paper by Bickmore et al. (2017; this volume), which attempts to connect bond energy to electrostatic characteristics, in this case electronegativity. The work is inspired by the observation that bond energies vary greatly across bond types. Perhaps the most intriguing implication is one left unsaid by the authors: they provide a possible fifth explanation for the rarity of many minerals, as enumerated by Hazen and Ausubel (2016; *Am Min*). Those authors suggested that rarity is typical for the more than 5000 minerals yet named, due to restricted P-T-X stability, planetary constraints, ephemeral stable conditions and collection bias. Bickmore et al. (2017) provide, if not an additional cause for rarity, then at least a possible rationale for ephemeral P-T-X stability, by postulating, for example, why peroxides are rare but persulfides are common. Peroxides are built upon O-O bonds, which have intrinsically less energy per bond valence than more ionic M-O bonds.

Not So Deep Diamond Inclusions?

On page 929 of this issue, Andrew Thomson reflects on some new and important observations by Uenver-Thiele et al. (2017) regarding the putative depths of mantle-derived diamonds. Some diamonds are thought to derive from depths of at least >800 km, on the basis of their containing magnesio-wüstite ($[Mg,Fe]O$), a phase that is not expected to be stable under subsolidus conditions in a pyrolite bulk composition (but is stable to atmospheric pressure in other bulk compositions). Even greater depths are suggested where some magnesioferrite phases occur as exsolution lamellae within

$[Mg,Fe]O$ but such inferences have not been verified by experiments at ambient pressure. Uenver-Thiele et al. (2017) conduct the needed experiments and ironically find that such exsolution relationships are likely to occur only at $P < 10$ GPa. Their new work does not preclude entrapment of inclusions at greater depths, but indicates that the exsolution textures in question represent an upper mantle phenomenon.

The Genesis of Arc Magmas

On page 931 of this issue, Christy Till reviews the conditions under which arc magmas are generated in the mantle wedge. She finds that while published P-T estimates of arc magma genesis vary greatly, the largest source of variation in these estimates is differences in their calculation methodology. Once calculated with a consistent approach, wet primitive arc magmas reveal origins via water-saturated partial melting at 20-35 kbar, with subsequent equilibration (prior to transport to the crust) over relatively narrow P and T intervals of 8-19 kbar and 1075-1300°C. Anhydrous arc magmas reveal similar depths of mantle equilibration en route to the surface but at higher temperatures (1290-1450°C), facilitated by channelized rather than porous flow. Till finds that these processes are sufficient to explain a rather wide range of arc magmas, from boninites to high Mg andesite to hydrous calc-alkaline basalt, leaving a lherzolite residue for the latter and a harzburgite residue for the former two. More importantly, though, Till is able to show how these P-T conditions can be mapped into different and distinct parts of the mantle wedge, which means that various volcanic composition suites may be used to describe the evolution of an ancient or evolving arc system.

Little Water is Transported Into the Mantle By Subducting Basalt

On page 975 of this issue, Schmädicke and Gose measure water contents in both garnet and omphacite in coesite-bearing eclogite. A key inference from their work is that molecular water in these phases is secondary, related to fluids that come into contact with the system following peak metamorphism. (The opposing possibility is that molecular water represents structural water that is exsolved upon decompression). In addition, molecular water may even secondarily enhance the content of structural water. In this case, only structural water of samples devoid of molecular water is useful for estimating water budgets in a downgoing basaltic slab, and these authors thus infer that such contents are quite low, on the order of 300-650 ppm, with most pre- and syn-metamorphic water being released to hanging wall rocks (e.g., the mantle wedge or exhuming high-pressure slices).

Remaking Zircon

On page 1066 of this issue Pidgeon et al. examine the recrystallization of radiation-damaged zircon. The recrystallization process first involves the formation of tetragonal zirconia, which then reacts with silica to recreate zircon. Their experiments indicate, however, that such recrystallization is highly unlikely in natural systems, and Pb and He loss would thus be permanent. They further note that recrystallization would be no more likely in synthetic zircons that are used to sequester radioactive waste, in which case radionuclides would be not be protected against reactions with fluids.

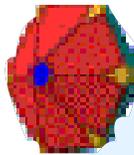
Letters - Animal, Vegetable, Mineral

On page 1129 of this issue, Hummer et al. provide the structure of one of the very few known organic minerals, in this case, a naturally crystalline geoporphyrin (porphyrins being a type of organic compound) called abselonite. This and related compounds are believed to be due to the breakdown under diagenesis of chlorophyll a, and the transformation to abselonite involves a highly specific change of cations from Mg to Ni(II).

Upcoming Local (or mostly local) Geology Events: Useful Mineral Links:

- June**
- 3 Spring Minerafest - Macungie, Pennsylvania - 68th semi-annual Minerafest
 - 3 Greensboro Gem & Mineral Club, Annual Show Piedmont Triad Farmers Market; 2914 Sandy Ridge Road, Colfax, NC
 - 3 Great Falls, VA—Geology field trip; 9–6; NOVA; info, reg: GOL 135 Website - <http://courses.vccs.edu/colleges/nova/courses/GOL135-FieldStudiesinGeology>
 - 3 National Limestone Quarries 1 & 2—Collecting field trip; 3499 Quarry Rd, Middleburg, PA; 8:30–4; RSVP: Bob Cooke, rdotcooke@gmail.com.
 - 3-4 Monroe, NY - Annual Orange County Gem & Mineral Show, Museum Village, off Rt. 17, Monroe, NY
 - 3-4 Canandigua, NY - Annual Wayne County Gem Fest - Canandigua Civic Center
 - 7 MSDC Meeting
 - 10 Calvert Cliffs, MD—Geology field trip; 9–6; NOVA; info, reg: GOL 135 Website
 - 14 GLMSMC Meeting
 - 14 Treasures of the Earth, Inc., Virginia Beach Convention Center; 1000 19th Street; Fri. 12-6, Sat. 10-5, Sun. 10-5
 - 16–17 Quarryville, PA—Annual show; Lancaster County Fossil and Mineral Club; Solanco Fair-grounds, Hoffman Bldg, 172 South Lime St; Fri 12–8, Sat 10–5; adults \$3; info: Eric Miller, ad-min@millermineralmine.com
 - 17 Southern Maryland Rock and Mineral Club Swap/Sale/Picnic, Gilbert Run Park; 13140 Charles Street, Charlotte Hall, MD, Sat. 9-5
 - 24 Rift Valley, Northern VA—Geology field trip; 9–7; NOVA; info, reg: GOL 135 Website
 - 26 NVMC Meeting
 - 28 MNCA Meeting
- July**
- 1-6 Spruce Pine NC, Annual show; Parkway Fire and Rescue, 136 Majestic View; Daily 10-6; Free Admission;
 - 22-23 Frankfort, NY - NEW LOCATION!! - 3rd Annual Herkimer Diamond Festival and Gem Show, at the Herkimer County Fairgrounds, 135 Cemetery St., Frankfort, NY (Approx. 7 miles from Herkimer, on Rt. NY 5S, 1 mile West of Ilion.)
- August**
- 11-13 W. Springfield, Mass. - Annual East Coast Gem & Mineral Show
 - 26-27 Canton, NY - Annual St. Lawrence County Gem & Mineral Show, Lincoln St. Park Pavilion
- September**
- 6 MSDC Meeting
 - 13 GSW Meeting - Alternate Location
 - 13 GLMSMC Meeting
 - 24 NVMC Meeting
 - 26 MNCA Meeting
- October**
- 4 MSDC Meeting
 - 11 GLMSMC Meeting
 - 23 NVMC Meeting
 - 25 MNCA Meeting
- November**
- 1 MSDC Meeting
 - 8 GLMSMC Meeting
 - 11-13 W. Springfield, Mass. - Annual East Coast Gem & Mineral Show
 - 22 MNCA Meeting - depending on Thanksgiving
 - 27 NVMC Meeting



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

MSDC Past Presidents

Name	Years served as President
Charles H. Robinson	1941-1945
James H. Benn	1946-1947
John J. Livingston	1948-1950
Phillip R. Cosminsky	1951
Benjamin J. Chromy	1952
John J. Livingston	1953-1954
Paul J. Rees	1954
Antonio C. Bonanno	1955
Paul E. Halter	1956-1957
John O. Griesback	1958
John Sinkankas	1959
William R. Smith	1960
Paul E. Desautels	1961
John R. Cranford	1962
Robert Highbarger	1963
Harry Van Tassel	1964
Grant C. Edwards	1965
Kenneth V. Zahn	1966
Douglas C. Alverson	1967-1968
Robert W. Dunning	1969
John W. Gruger	1970-1971
Angelo G. Cicolani	1972-1973
William H. Wilkinson	1974
Ellsworth E. Sinclair	1975-1976
Angelo Cicolani	1977-1978
	1979
Cynthia C. Payne	1980
Paul E. Smith	1981-1982
Fred C. Schaefermeyer	1983-1984
Erich Grundel	1985
James O'Connor	1986-1989
Erich Grundel	1990
Wilson (Ed) Fisher	1991-1996
Jennie Smith	1996-1997
Wilson (Ed) Fisher	1998-2003

Name	Years served as President
Andy Thompson	2004-2010
Tom Tucker	2011-2012
Stephen Johnson	2013-2015
David Nanney	2016-present

**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? _____

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, 10th 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

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NEWSLETTER OF THE MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA

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