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The Mineral

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May Program

“Poland's Treasures - Amber and Salt”

Presented by Denise Nelson

For travelers who are lovers of minerals and gemstones, Poland is a great destination. Our presenter this month, Denise Nelson, is going to tell us about two of Poland’s treasures – Amber and Salt (mineralogically, Halite). Denise the president of the Gem, Lapidary and Mineral Society of Washington, D.C., one of our EFMLS sister clubs. She is a Graduate Gemologist (GIA) and Appraiser. Denise had the opportunity to take an enjoyable two-week journey to Poland and will share with us some of the interesting parts of that trip that overlap with our areas of interest.

The first of Poland’s treasures that Denise will discuss is a gemstone that is not in fact a mineral. Amber is fossilized resin (tree sap) that occurs in sedimentary environments. Strictly speaking, it is a hydrocarbon polymer - organic, not inorganic. It is created when the buried resin is subjected to high pressure and temperatures produced by overlying sediments, driving off some of the hydrocarbon volatiles and transforming the resin into amber. This doesn’t happen overnight. The large quantities of amber found around the coastline of the Baltic Sea, including the coast of Poland, date from 44 million years ago (the Eocene epoch). Although amber is not a mineral, it is often treated as one in jewelry. The fossilization process has hardened the fossilized tree resin giving it a Moh’s hardness of 2-2.5, about the same as gypsum. Despite its relative softness, it can be shaped and polished and used as a

Prez Says...
by Dave Nanney
MSDC President



April certainly bridged

our winter into spring. We’ve had snow, rain, WINDS, and a couple of perfect sun lit, here comes the spring, days. Leslie and I celebrated our 50th anniversary with a three phase trip. We traveled to San Diego to welcome a relative into the ranks of the married world. A couple of days later, we celebrated our actual anniversary in Little Rock, Arkansas with a number of our azalea friends. We then attended the Azalea Society of America annual convention where we again ran into sleet, rain, snow, lightning, thunder, and one really nice but breezy day.

And then came our mineral time. Hot Springs, Arkansas is known for its quartz. Robert Ramik is a friend we met through his partner Laura Grant at azalea and rhododendron gatherings. Turns out he worked at the Toronto Mineral Museum, has a mineral named after him (Ramikite), and is a serious rockhound. So post-convention, we traveled to Hot Springs to dig at the Crater of Diamonds, the only place in the world (I’m told) where the public can dig for and keep diamonds. It is a lamproite pipe where they report 600 diamonds are discovered by the public annually. We moved a lot of dirt, saw sparkly mica, and found nothing. But for the record, been there, done that!

Our next adventure, thanks to a connection from Tom Tucker, is we visited Michael Howard, the preeminent Arkansas geologist, now retired. He is selling his personal collection, and some of it just happened to come home with us. He also gave us directions to several quartz dealers and quarries, including a friend who primarily sells on the web.

Coleman's Rock Shop is located next to their quartz quarry. After reviewing their offerings, lusting over one which was ridiculously priced, we paid to dig through their dumps. Daily dump truck loads of rock are hauled to the dump allowing the public to dig for quartz. Found a bunch of dinged up non-collectables but again can say, been there, done that!

March Business Meeting Synopsis

By Andy Thompson, Secretary

Dave Hennessey, standing in for President Dave Nanney, called the April meeting to order and, for their service, thanked three past MSDC presidents in attendance. Dave welcomed guests Caitlin, Brooke and Matthew as well as several friends and former MSDC members who were especially interested in the evening's program.

The March Business Minutes summary was approved as published in the April Mineral Minutes newsletter.

For 'Geology in the News,' members noted the passing of Ms. Gerry Fox of the Northern Virginia Club. Geraldine "Gerry" Anne (Vang) Cox died on March 22 after a courageous battle with cancer. She was a very active contributor, both at the national and local levels, to helping mineral collectors. The April 2018 NVMC newsletter, page 10, provided information on her diverse expertise and her contributions to all things mineralogical and environmental. It is found at <https://www.novamineralclub.org/sites/default/files/newsletters/2018-04/NVMC%20newsletter%202018-04.pdf>

Also noted was news of the ongoing research into an initially puzzling fossil which researchers now recognize as that of a juvenile T Rex unearth in Montana. Paleontologists excavating in Montana's famous Hell Creek Formation uncovered the score of a lifetime—one of the best preserved and complete juvenile Tyrannosaurus Rex skeletons ever found. "This is a 1-in-100-million specimen . . ." See: www.history.com/news/tyrannosaurs-rex-montana-paleontology-discovery

With no further topics for discussion at hand, Dave called for and received a motion to close the business meeting, which was seconded and approved.

Our final stop was to head to Mount Ida. Despite Susan Fisher telling us there is nothing there, and there isn't, we wanted to visit a location we had acquired nice specimens from in the past. We were given a contact by Mike Howard located in route. We arrived unannounced, and expected to be turned away, only to find a treasure troth of quartz. Stu Schmidt had owned a quartz mine, having retired from the Navy to fish and mine quartz. He had two garages full of treasures, at extremely good prices. I can only say that Leslie made me stop saying we don't have shelf room for everything I wanted. It was the perfect end of a great anniversary trip.

I hope to see everyone at our May meeting. I will be bringing two of our new treasures to show off. We also are going to review our shelves for minerals from Poland, in honor of this month's talk by Denise Nelson. After John Weidner's excellent garnet talk in March, we've been talking about expanding the mineral sharing part of our meeting. Please search for a couple of treasures and tell us about them.

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

CLUB INFO

MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA

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/MineralogicalSociety-OfTheDistrictOfColumbia

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gemstone, like the minerals we recognize as precious and semi-precious gemstones.

The other of Poland's treasures that Denise will discuss is a place I definitely want to get to one day. The Wieliczka Salt Mine in Krakow, Poland is featured on Page 434 of a book I own that is titled "501 Must-Visit Destinations". The mine has been hosting touring visitors since the mid-1800's and my destinations book declares it "no less magnificent than the Egyptian pyramids". The mine is approximately 1,000 feet deep and is more than 900 years old. It continues to operate to this day, producing approximately 20 tons of salt each day. I do not want to say any more about it and steal the thunder from our presenter's program, except to say that you will be amazed.

Please join us in taking Denise to dinner on May 2nd 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 plan to come to dinner, please send an e-mail to me (davidhennessey@comcast.net) and let me know so I can try to get the number right for the reservation - but do not hesitate to come to dinner if you forget to e-mail. We can always make room for more around the table. 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 Denise's presentation.

April Program: "Recent Acquisitions for the National Collection"

Presented by Dr. Jeffrey Post

By Andy Thompson, Secretary

Dave Nanney, standing in for MSDC Program Chair Dave Hennessey, introduced John Weidner, MSDC Treasurer, as a Ph.D. in mathematics, former university professor, and a man "in recovery" from an enduring cold. In addition, John is a fellow Virginian whose house recently lost power for several days due to stormy weather immediately prior to the evening's presentation.

V.P. Dave Hennessey introduced Dr. Jeffrey Post, Curator in Charge of the Smithsonian national collection of gems and minerals, and one of MSDC's favorite presenters. His purpose was to give an overview of recent acquisitions the Mineral Sciences Department made for the national collection and provide an update on the Mineral Sciences Department and its recent research contributions.

Jeffrey made clear from the beginning that the driving force behind the mineral acquisitions was to add specimens which fill in the collection's holes so it better represents the mineral universe, both geographically and educationally. Additional criteria included acquiring specimens which enable Smithsonian researchers and partnering museum and university colleagues throughout the world to conduct important research which furthers the mission of the Smithsonian, the increase and diffusion of knowledge.

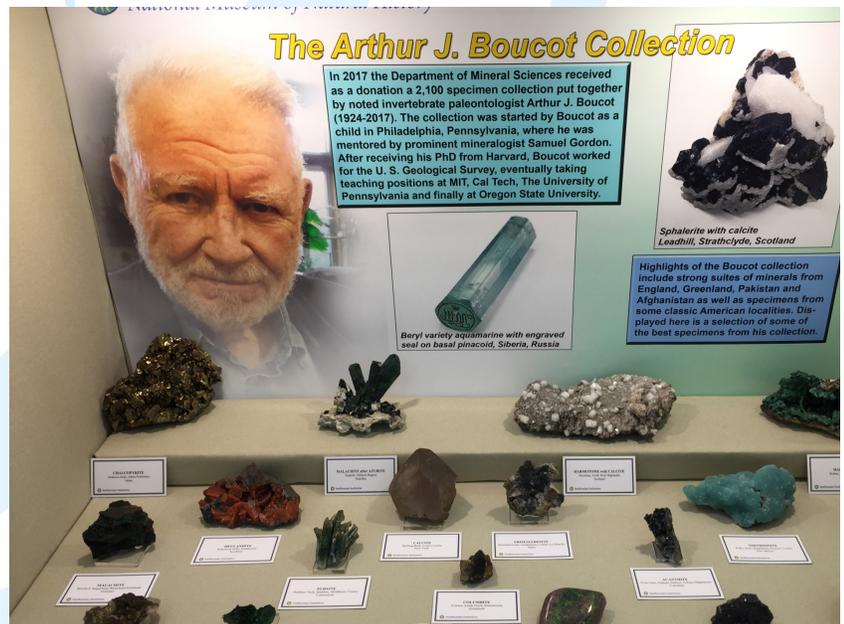
The first specimen he showed was a dazzlingly colorful,

egg-shaped opal from Ethiopia. This gift to the Smithsonian is unique in that it is so different from the best, more recent Ethiopian opals that are uniformly white and translucent. This gem is multi-colored, opaque and has a honey-combed appearance, a configuration which Jeff said is not well understood. Additionally, Ethiopian opals are relative new-comers on the world stage and different from the Australian opals with which most collectors are familiar.



Occasionally the Department receives a gift of minerals which Jeff said lifts the national collection to higher qualitative level. Such was the case when invertebrate paleontologist Arthur J. Boucot passed away in 2017 and the family donated to the Smithsonian his collection of 2100 remarkable minerals. The Mineral Sciences Department (MSD) made a showcase of 21 of the most interesting specimens which they displayed at the recent Denver annual mineral show. Dr. Boucot had a career spanning from his student days at Harvard (Ph.D.) in the east, to teaching as a professor at Oregon University in the west, and worked with USGS and three universities in between. Jeff called particular attention to the display's top shelf specimens which included a beautiful chalcocopyrite from Japan and several large malachites.

One member of the audience asked if the Smithsonian keeps all the items when a donor gives a large collection, such as those donated by the Boucot family. "We typically find a use and place for all of them Jeff replied." Some



might be used for in-house or a traveling displays, some for research, and others for educational purposes such as in the Q?rious interactive science room in the National Museum of Natural History.

Rarity is another criteria the Smithsonian's MSD uses in seeking out appropriate specimens to add to the national collection. The tube-like beryl specimen from Minas Gerais, Brazil, here pictured is very unusual in that it has 12, rather than the normal 6 sides. It also is translucent and has a well displayed interior structure.

The large rough diamond, 88.63 carats, from South Africa, is interesting simply because of its unusual size. Due to its lack of clarity, it is not particularly costly.

The chrysoberyl from Madagascar is rare because of its unusual bright yellow color. This specimen is already on



display in the new acquisitions case.

One of the most interesting puzzles in the history of gems has been the origin of the Hope Diamond. Jeff led a



team of Smithsonian colleagues in a research project which documented that the Hope is the same gem which originally came from India and was then bought by King Louis the XIVth. His lapidary craftsmen cut it to his royal standards



and it was then stolen in 1791, recut to a smaller size to disguise its origins and sold to a London banking family in 1839. Thereafter it transferred to a succession of British and American owners. Acquired by Evalyn Walsh McLean, she passed on to Harry Winston of New York who gifted it to the NMNH in 1958, where it has been displayed and has drawn large crowds ever since. The much larger size of the French Blue and unique color raised questions about whether it could be the source of today's 45.5 carat Hope Diamond. For decades without the assistance of computers and other high-tech instruments, the puzzle could not be solved.

The Smithsonian team's project, to determine whether the Hope Diamond could have originated from the French Blue, required considerable international research and high-tech sleuthing. Based on historical descriptions and drawings, he team made computer-generated replicas of the three models, the Indian, French and Hope diamonds which are shown below. Those models, along with careful color comparisons, provided convincing evidence the Hope Diamond very probably originated from the French Blue. Jeff noted the three models will probably become a traveling exhibit in 2019.



During the investigation, the Smithsonian team also discovered a previously unknown insight about how the

French lapidary craftsmen responsible for faceting the original Indian diamond introduced a clever angle. The French Blue, originally displayed in a gold holder, was cut so King Louis could look through one tiny hole in the display stem's holder, where two oddly flat facets had been introduced to enable the King to see golden rays reflecting off the gold mounting. It gave the viewer the impression the golden light was coming from within the interior of the blue gem. Researchers speculated this was a clever affirmation of the monarch's title, the Sun King.

One of the most stunning recent additions to the national collection came about as a gift from a very generous Smithsonian supporter, Dr. Coralyn Wright Whitney. Unlike most topaz, which are yellow, this gem is a deep red, 48.84 carats in size, and stands in the shape of a brilliant flame.



This mineral, like many of the recent acquisitions, fluoresces bright orange, due, in this case, to the presence of chromium.

Jeff showed photos of several dozen additional newly acquired unique minerals, each with interesting aspects, some of which may well fuel further research. The cause of color in mineral specimens, is a particular question which the Smithsonian scientists can now successfully probe thanks to its new high-tech instrumentation. Mineral specimens, such as the newly acquired multicolored goethite, from Graves Mountain, Georgia, is a case in point, begging for an explanation.

Lastly, Jeff answered people's questions about the state of the NMNH Mineral Science Department. Listeners were encouraged to learn that the Department's having functioned for the last several years with a declining number of scientists, has just recently received permission to fill five new positions, one of which is for a mineralogist. This is crucial because without a continuity in staff, the expert corporate memory of what is in the national collection, and what specimens are further needed, is not possible. Jeff added, the Department recently lost the services of long-time former mineralogist Dr. Peter J. Dunn (1942-2017). Pete had specialized in fluorescent minerals from Franklin, New Jersey. Upon retirement, he continued as a volunteer



within the Department, for the next ten years. And will be greatly missed by his colleagues.

Jeff said the NMNH is a great place to work and not the least reason is the high quality of mineralogical work that is possible due to the availability of instrumentation which makes detailed technical analysis possible. The Field Emission Gun Electron Microprobe and the Raman Microscope and Spectrometer for example, now allow imaging and analysis of tiny samples which do not require destruction or altering of the minerals. These recently acquired tools speed up the formerly time-consuming process of mineral identification and will further NMNH research for the next twenty years, Jeff said.



The presentation was met with enthusiastic applause. Dave Hennessey expressed his and the club's deep appreciation to Jeff and to the Department for sharing these contributions to mineralogy.

“Show and Tell”

Since our presentation this month is focused on Poland amber and salt, let's see what we can come up with related to the presentation. Amber comes not just from Poland but from a variety of worldwide localities, including Cape Sable, Maryland and Sayreville, New Jersey! Does anyone have any amber to show us? Also, salt (NaCl) is known by the mineral name “halite” and is in the halide mineral family. The halide mineral class includes those minerals with a dominant halide anion (Cl-, Br-, F- and I-). In addition to halite, some of the more attractive halide minerals include atacamite and fluorite. I know many of us have show-worthy halides in their collection. Bring them in and let us see them. Or bring in anything else you want to show us, just because it's interesting. If it interests you, it will interest us.

Geologist identifies hidden clues to ancient supercontinents, confirms Pannotia.

An Ohio University geologist who first proposed the now-accepted supercontinent cycle theory in the 1980s has rallied to the cause of one of those supercontinents, Pannotia, that is in danger of being overlooked.

Dr. Damian Nance, Distinguished Professor of Geological Sciences, said the supercontinent cycle is known to have had a profound influence on the course of Earth history and the evolution of its oceans, atmosphere and biosphere, and is now thought to be, in addition, the dominant influence on the circulation of the Earth's mantle, even fundamentally affecting the behavior of Earth's magnetic field.

"We now know a whole lot more about what's going on between the surface and the Earth's core," Nance said. "It seems quite clear now that the supercontinent cycle plays an enormous role in the circulation of the material in the Earth's mantle, and that has an impact on the Earth's magnetic field. It's taken the implications of the cycle to a whole new level. That's really pretty fundamental stuff."

Nance and Ohio University colleague Tom Worsley proposed the supercontinent cycle in the early 1980s. Based on data available at the time, they proposed the existence of five supercontinents that pre-dated the well-known Pangaea supercontinent. Some of them have been accepted, such as the supercontinent Rodinia, which came together about 1,100 million years ago, and Columbia, which broke up some 400 million years before that. However, the most recent pre-Pangaean supercontinent, Pannotia, is still subject to disagreement. Nance and Worsley argued that it came into existence about 600 million years ago.

"When we first put forward this supercontinent cycle idea, this was one of the supercontinents we had identified from the data we had at that time, and we weren't the only ones who have done so," Nance said. "In the intervening 20 or 30 years, an awfully lot has been made of some of the earlier supercontinents we had proposed, but this one has been shortchanged, largely because the database which has allowed these things to be identified has not been able to nail this one down very successfully."

The understanding of much of that data has changed since the 1980s, he added. Another group had published a paper in the 1980s that documented the breakup of a supercontinent, later called Pannotia. But later dating suggested this breakup occurred at around the same time it would have formed, leading some to question whether it ever actually existed. However, subsequent changes to the geologic time scale indicates a broader gap for Pannotia to have existed, he said.

The new paper, published by Nance and colleague Brendan Murphy of St. Francis Xavier University in Nova Scotia, Canada, is titled "Supercontinents and the case for Pannotia." It was published by the Geological Society of London. Nance and Murphy argue that the recognition of past supercontinents need not rely solely on continental reconstructions, but can also exploit a variety of phenomena that accompany their assembly and breakup.

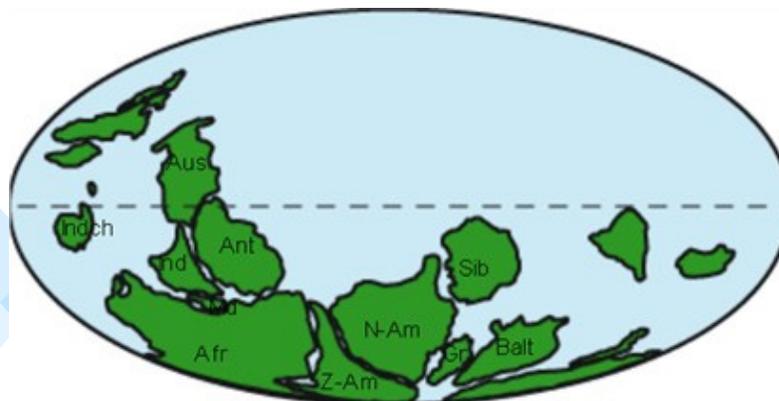
For example, supercontinent assembly is accompanied by worldwide mountain building as the continents collide, just as evidence of continental rifting will accompany supercontinent breakup. Similarly, supercontinent assembly fosters extinctions as surface conditions change and habitats are destroyed, whereas breakup fosters radiations as new habitats are created.

Supercontinents also affect the world's sea level, ocean chemistry and climate in predictable ways and produce an array of isotopic signals that can be identified in rocks. When the geologic record is examined for evidence of these accompanying phenomena, the case for Pannotia is unmistakable, they argue. The time interval encompassed by the assembly and breakup of Pannotia was accompanied by some of the most profound changes in Earth history, changes that were heralded by widespread mountain building, followed by global evidence of continental breakup, and affected the Earth's oceans, atmosphere, biosphere and climate just as predicted.

These signals, Nance and Murphy caution, argue strongly for the existence of Pannotia, and to ignore them and dismiss this supercontinent is to potentially overlook the profound changes in mantle circulation that likewise accompany the assembly and breakup stages of the supercontinent cycle.

Story Source: Materials provided by Ohio University. Note: Content may be edited for style and length.

Journal Reference: R. Damian Nance, J. Brendan Murphy. Supercontinents and the case for Pannotia. Geological Society, London, Special Publications, 2018; DOI: 10.1144/SP470.5



From Wikipedia: Pannotia (from Greek: pan-, "all", -nótos, "south"; meaning "all southern land"), also known as Vendian supercontinent, Greater Gondwana, and the Pan-African supercontinent, was a relatively short-lived Neoproterozoic supercontinent that formed at the end of the Precambrian during the Pan-African orogeny (650–500 Ma) and broke apart 560 Ma with the opening of the Iapetus Ocean. Pannotia formed when Laurentia was located adjacent to the two major South American cratons, Amazonia and Río de la Plata. The opening of the Iapetus Ocean separated Laurentia from Baltica, Amazonia, and Río de la Plata.

Water appeared while Earth was still growing

Until about ten years ago, scientists thought they had a pretty good picture of how the moon and Earth came to co-exist. Then more precise measurements blew it all wide open, and scientists are still struggling to reconcile them.

As part of that effort, a team including UChicago cosmochemist Nicolas Dauphas performed the largest study to date of oxygen isotopes in lunar rocks, and found a small but measurable difference in the makeup of the moon and Earth.

Published March 28 in *Science Advances*, the research proposes that Earth acquired the majority of its water during the main stage of its growth -- which counters a popular theory.

The most widely accepted theory of the origin of the Moon speculates that a giant object smashed into the proto-Earth at just enough velocity that part of both bodies broke off and formed the moon. The Earth has a little of the moon and the moon has more of the Earth, but they'd be mostly different objects. Early measurements -- many taken by the late UChicago geochemist Robert Clayton -- did not have sufficient precision to tell the Moon and Earth apart.

But in the last decade, Dauphas said, it became clear this picture wasn't quite right. Elements can come in different forms, called isotopes, and these give scientists clues to the rock's origin. As ways to measure isotopes improved, scientists discovered striking similarities between the moon and the Earth. Referred to as the "lunar isotopic crisis," this was a problem for the main theory of lunar formation, because it's highly unlikely the isotopes would be exactly the same for two random objects in the solar system.

"This, to my mind, is one of the most compelling questions in modern planetary science," said Dauphas, head of the Origins Laboratory and professor in the Department of Geophysical Sciences and the Enrico Fermi Institute. "Right now it's completely open. It's amazing to still be asking this."

One theory to explain the matching isotopes was a scenario in which the proto-Earth was totally vaporized by one or more giant impacts, and both it and the moon formed out of the cloud. But one of the major uncertainties is that scientists have reached different conclusions about how different the oxygen isotopes are between lunar and terrestrial rocks.

Seeking to clarify the issue, the researchers measured the oxygen isotopes of both lunar and terrestrial rocks with extremely high precision. They found a very small, but detectable difference between the isotopes between the two bodies.

To explain the near match, the authors turn to water. A popular theory is that the Earth got the majority of its water after the great impact, as more objects containing ice hit the Earth as meteorites. (The term to describe it is late veneer, meaning that water is delivered to the Earth as a veneer after the Earth has completed its growth.)



Meteorites such as these carbonaceous chondrites are thought to have delivered water to the Earth—but an outstanding question is when. A new study points to the early incorporation of water in the growing Earth. Credit: Image courtesy Nicolas Dauphas

But if most of Earth's water was delivered via later meteorites, this would have shown up as a greater isotopic difference than what the researchers measured -- as water-bearing meteorites have unusual mixtures of oxygen isotopes.

Their model suggests that only 5 percent to 30 percent of all the water on Earth would have arrived on meteorites after the great impact.

Dauphas noted the picture is still evolving because depending on which element you measure, differences between the moon and Earth could be found. "Oxygen, titanium, tungsten -- these are the ones that are still keeping us up at night," he said.

The question of how planets acquire water is interesting for a number of reasons, Dauphas said, including the search for distant exoplanets that might have water -- and thus a similar kind of life.

Richard Greenwood with the UK's Open University led the study. Other coauthors hailed from the British Antarctic Survey, London's Natural History, the Museum University of Western Brittany and the Center for Research in Economics and Statistics in France.

Story Source: Materials provided by University of Chicago. Note: Content may be edited for style and length.

Journal Reference: Richard C. Greenwood, Jean-Alix Barrat, Martin F. Miller, Mahesh Anand, Nicolas Dauphas, Ian A. Franchi, Patrick Sillard, Natalie A. Starkey. Oxygen isotopic evidence for accretion of Earth's water before a high-energy Moon-forming giant impact. *Science Advances*, 2018; 4 (3): eaao5928 DOI: 10.1126/sciadv.aao5928

Two-billion-year-old salt rock reveals rise of oxygen in ancient atmosphere

A 2-billion-year-old chunk of sea salt provides new evidence for the transformation of Earth's atmosphere into an oxygenated environment capable of supporting life as we know it.

The study by an international team of institutions including Princeton University found that the rise in oxygen that occurred about 2.3 billion years ago, known as the Great Oxidation Event, was much more substantial than previously indicated.

"Instead of a trickle, it was more like a firehose," said Clara Blättler, a postdoctoral research fellow in the Department of Geosciences at Princeton and first author on the study, which was published online by the journal *Science* on Thursday, March 22. "It was a major change in the production of oxygen."

The evidence for the profound upswing in oxygen comes from crystalized salt rocks extracted from a 1.2-mile-deep hole in the region of Karelia in northwest Russia. These salt crystals were left behind when ancient seawater evaporated, and they give geologists unprecedented clues to the composition of the oceans and atmosphere on Earth more than 2 billion years ago.

The key indication of the increase in oxygen production came from finding that the mineral deposits contained a surprisingly large amount of a component of seawater known as sulfate, which was created when sulfur reacted with oxygen.

"This is the strongest ever evidence that the ancient seawater from which those minerals precipitated had high sulfate concentrations reaching at least 30 percent of present-day oceanic sulfate as our estimations indicate," said Aivo Lepland, a researcher at the Geological Survey of Norway, a geology specialist at Tallinn University of Technology, and senior author on the study. "This is much higher than previously thought and will require considerable rethinking of the magnitude of oxygenation of Earth's 2-billion year old atmosphere-ocean system."

Oxygen makes up about 20 percent of air and is essential for life as we know it. According to geological evidence, oxygen began to show up in the Earth's atmosphere between 2.4 and 2.3 billion years ago.

Until the new study, however, geologists were uncertain whether this buildup in oxygen -- caused by the growth of cyanobacteria capable of photosynthesis, which involves taking in carbon dioxide and giving off oxygen -- was a slow event that took millions of years or a more rapid event.

"It has been hard to test these ideas because we didn't

have evidence from that era to tell us about the composition of the atmosphere," Blättler said.

The recently discovered crystals provide that evidence. The salt crystals collected in Russia are over a billion years older than any previously discovered salt deposits. The deposits contain halite, which is called rock salt and is chemically identical to table salt or sodium chloride, as well as other salts of calcium, magnesium and potassium.

Normally these minerals dissolve easily and would be washed away over time, but in this case they were exceptionally well preserved deep within the Earth. Geologists from the Geological Survey of Norway in collaboration with the Karelian Research Center in Petrozavodsk, Russia, recovered the salts from a drilling site called the Omega Parametric Hole (OPH) on the western shores of Lake Onega.



A sample of 2-billion-year-old salt (pink-white recrystallized halite) with embedded fragments of calcium sulfate from a geological drill core in Russian Karelia. Credit: Photo by Aivo Lepland, Geological Survey of Norway; courtesy of Science/AAAS

The unique qualities of the sample make them very valuable in piecing together the history of what happened after the Great Oxidation Event, said John Higgins, assistant professor of geosciences at Princeton, who provided interpretation of the geochemical analysis along with other co-authors.

"This is a pretty special class of geologic deposits," Higgins said. "There has been a lot of debate as to whether the Great Oxidation Event, which is tied to increase and decrease in various chemical signals, represents a big change in oxygen production, or just a threshold that was crossed. The bottom line is that this paper provides evidence that the oxygenation of the Earth across this time period involved a lot of oxygen production."

The research will spur the development of new models to explain what happened after the Great Oxidation Event to cause the accumulation of oxygen in the atmosphere, Blättler said. "There may have been important changes in feedback cycles on land or in the oceans, or a large increase in oxygen production by microbes, but either way it was much more dramatic than we had an understanding of before."

Story Source: Materials provided by Princeton University. Note: Content may be edited for style and length.

Journal Reference: C. L. Blättler, M. W. Claire, A. R.

Prave, K. Kirsimäe, J.A. Higgins, P. V. Medvedev, A. E. Romashkin, D. V. Rychanchik, A. L. Zerkle, K. Paiste, T. Kreitsmann, I. L. Millar, J. A. Hayles, H. Bao, A. V. Turchyn, M. R. Warke, A. Lepland. Two-billion-year-old evaporites capture Earth's great oxidation. *Science*, 2018; eaar2687 DOI: 10.1126/science.aar2687

Diamond discovery under pressure

For the first time, scientists have found Earth's fourth most abundant mineral -- calcium silicate perovskite -- at Earth's surface.

"Nobody has ever managed to keep this mineral stable at the Earth's surface," said Graham Pearson, a professor in the University of Alberta's Department of Earth and Atmospheric Sciences and Canada Excellence Research Chair Laureate. He explained the mineral is found deep inside Earth's mantle, at 700 kilometres.

"The only possible way of preserving this mineral at the Earth's surface is when it's trapped in an unyielding container like a diamond," he explained. "Based on our findings, there could be as much as zetta tonnes (10²¹) of this perovskite in deep Earth."

Pearson and colleagues from UBC found the calcium silicate perovskite within a diamond mined from less than one kilometre beneath Earth's crust, at South Africa's famous Cullinan Mine, best known as the source of two of the largest diamonds in the British Crown Jewels. Pearson explained that the diamonds from the mine are among not only the most commercially valuable in the world, but they are also the most scientifically valuable, providing insight into the deepest parts of Earth's core.

He said the particular diamond in question would have sustained more than 24 billion pascals of pressure, equivalent to 240,000 atmospheres. The diamond originated roughly 700 kilometres below Earth's surface, whereas most diamonds are formed at 150 to 200 kilometres depth.

"Diamonds are really unique ways of seeing what's in the Earth," said Pearson. "And the specific composition of the perovskite inclusion in this particular diamond very clearly indicates the recycling of oceanic crust into Earth's lower mantle. It provides fundamental proof of what happens to the fate of oceanic plates as they descend into the depths of the Earth."

He said the discovery once again highlights the uniqueness of diamonds being able to preserve things that we otherwise would never be able to see.

"And it's a nice illustration of how science works. That you build on theoretical predictions in this case from seismology and that once in a while you're able to make a clinching observation that really proves that the theory works," said Pearson.

One of the best known diamond researchers in the world, Pearson was also behind the major 2014 discovery of ringwoodite -- Earth's fifth most abundant mineral -- in a diamond that pointed to a vast reservoir of water bound to silicate rocks in Earth's mantle.

Pearson worked with an international team of researchers including one of the best X-ray crystallographers in the world, Fabrizio Nestola from Padova, Italy, as well as scientists from the Deep Carbon Observatory in Washington, DC.

This research also saw Pearson team up with colleagues from the University of British Columbia who together lead a program -- the Diamond Exploration Research and Training School, part of NSERC's Collaborative Research

and Training Experience -- to train the next generation of highly qualified diamond explorers.

"CaSiO₃ perovskite in diamond indicates the recycling of oceanic crust into the lower mantle," will be published in the March 8 issue of Nature.

Story Source: Materials provided by University of Alberta. Note: Content may be edited for style and length.

Journal Reference: F. Nestola, N. Korolev, M. Kopylova, N. Rotiroti, D. G. Pearson, M. G. Pamato, M. Alvaro, L. Peruzzo, J. J. Gurney, A. E. Moore, J. Davidson. CaSiO₃ perovskite in diamond indicates the recycling of oceanic crust into the lower mantle. Nature, 2018; 555 (7695): 237 DOI: 10.1038/nature25972

Crystal Formations and Their Meanings

From GeologyIn.com

Crystals are the outer form of a mineral's inner order. Nearly every piece of rock of Earth is made of minerals, each of which is defined as a natural substance with a precise recipe and arrangement of atoms.

Crystal Point: A single terminated crystal which can have many of the other features below.

Double Terminated: Features: A single crystal with a termination at each end.

Twin: Two Crystal Points which are joined together by their side facets from the base up. Also known as a Companion.

Cluster: A group of many Crystal Points which grow from the same base.

Geode: A hollow rock which contains hundreds of crystals growing inside it.

Key: A hexagonal or angular shaped recess usually on the side facets of a crystal and near the base.

Rainbow: A rainbow reflection inside the crystal, caused by a special flaw. Only seen when it catches the light.

Inclusion: Other minerals caught inside a crystal. May appear as darker material or bits suspended inside the crystal.

Phantom: A ghost like 3D image of a crystal point inside a crystal. Shows the earlier size before it grew bigger. Some crystals have multiple Phantoms.

Isis Face: A five sided face with a tall point at the top. Also known as an Isis Crystal.

Generator: A Crystal Point with six equal sized triangular

faces and a very central termination.

Window: A diamond shaped extra face on a Crystal Point. Also known as a Sixth Face.

Bridge: Bridge Crystals have at least one smaller crystal sticking out and penetrating the main body of the crystal.

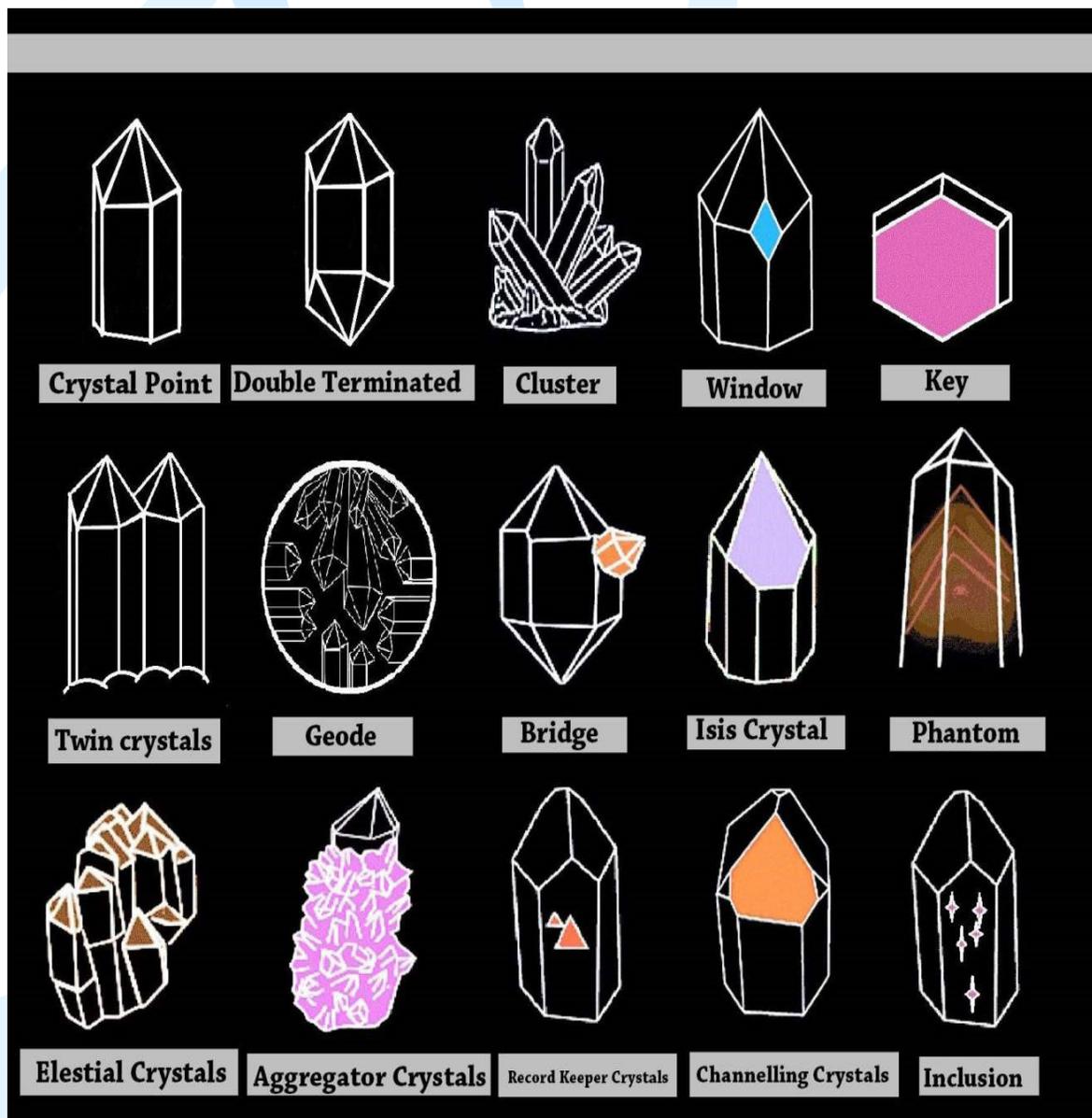
Channelling: Channelling Crystals have a large seven sided face with two small triangular face on either side and one triangular face directly behind the main face.

Record Keeper: Record Keeper Crystals have one or more triangles visible on one or more faces of the crystal.

Elestial: Elestial Crystals are multiple points growing from the same main crystal body.

Aggregator: Aggregator Crystals are large crystals partially or totally covered in smaller crystals.

<http://www.geologyin.com/2018/03/crystal-formations-and-their-meanings.html#s5Bwtw0JqVIFqEmh.99> Follow us: @GeologyTime on Twitter



GeologyIn.com

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 February 2018 issues of the *American Mineralogist: Journal of Earth and Planetary Materials*.

<http://www.minsocam.org>

XANES Analyses of Ferric/Ferrous Ratios of Basaltic Glasses

On page 489 of this issue, Cottrell et al. show that ferric/ferrous ratios of hydrous basaltic glasses are increased by exposure to synchrotron radiation. They find that XANES (X-ray Absorption Near Edge Structure) spectra are affected by radiation dose, total water content, and initial ferric/ferrous ratio. The mechanism of radiative oxidation appears to involve the loss of H from water-bearing samples. The authors provide analytical strategies so as to obtain accurate ferric/ferrous ratios from XANES spectra of hydrous basalts.

Vermiculite Insulation Analyses Made Quick and Easy

On page 571 of this issue Swayze et al. use portable reflectance spectroscopy to characterize the source and type of expanded vermiculite samples in various materials, ranging from attic insulation to potting soil. By applying multiple analytical methods they are able to show that in situ reflectance spectroscopy may be a powerful tool for reconnaissance or preliminary investigations, to determine whether such materials may be derived from a source known to contain asbestiform materials. Their methods do not identify materials as asbestiform-bearing (so our lead-in is misleading), but their work shows that the five ore sources investigated are sufficiently distinct in mineralogy and mineral chemistry that it might be possible to identify a source material from in situ analyses.

Sequestering Cesium

On page 623 of this issue, Osuna et al. synthesize a new type of high-Na mica that may provide a more effective barrier and absorber of radioactive waste compared to bentonite. Their work shows that natural materials can be used as a model to create synthetic analogs, with more targeted and desirable qualities. In this case, they show that their Na-mica-n material can absorb large fractions of Cs from low-Cs solutions; although efficiency appears to decrease dramatically with increasing Cs in solution the partitioning of Cs between mineral and fluid is always > 1 .

A New Feldspar Barometer

On page 600 of this issue, Befus et al. show that certain vibrational modes of feldspars, visible in Raman spectra, are sensitive to pressure. Their experiments are performed at ambient temperatures and the spectroscopic measurements are made at the pressures of interest. But their analysis of bulk moduli indicate that Ab-rich feldspars that occur as inclusions may preserve pressures of formation of natural systems, perhaps with some independence of temperature. These experiments indicate that Raman spectroscopy may prove to be a more valuable tool for comparison to some highly T-dependent feldspar barometers based on chemical equilibrium.

A Model for the Control On Erupted Lava Compositions

On page 565 of this issue, Conway et al. provide a comprehensive geochronological and geochemical study of the long-lived (200 ka) Ruapehu Volcano, in New Zealand. Of their varied findings, one in particular involves a pronounced temporal shift in the kinds of materials erupted. Felsic samples yield evidence of a peak in crustal assimilation at 50-35 ka, coincident with the eruption of Mg-rich andesites, and so presumably, a peak in heat transfer from the mantle to the crust. Evolved magmas from later eruptives acquire their compositions through crystallization differentiation and, to a lesser degree than the preceding magmas, crustal assimilation, presumably because mantle-to-crust heat fluxes are lower, and because low-T fusion fractions of the crust are exhausted. In this model, it is not

density filtering, but rather thermal maturity that determines the kinds of materials erupted from a given volcano.

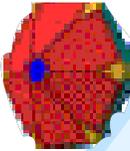
Time Between Magma Mixing and Eruption

On page 582 of this issue, Oeser et al. use Fe-Mg chemical and isotopic zoning of olivine grains to determine the time between magma mixing and eruption at Irazu volcano in Costa Rica. Furthermore, their combination of major and trace element and isotopic analyses allow them (a) to estimate diffusivities of some trace elements (Cr, Al, V) relative to Fe-Mg diffusion in olivine, and (b) to identify three populations of olivine crystals, that appear to derive from near the Moho, at a range of lower- to mid-crustal levels, and from a shallow staging reservoir. Diffusion profiles and a step-wise approach to modeling multi-stage histories, yield time scales of 100-1750 days between entrainment of the diversely zoned crystals and eruption. Most crystals yield times scales of a few months to two years.

Apatite Reaches Maturity

On page 550 of this issue, Drouet et al. discuss the results of complementary experiments that mimic the growth and reactivity of biogenic apatite in cases such as bone remodeling. They underline that incipient nano-scale apatite crystals are non-stoichiometric and coated by a highly reactive hydrated layer that is non-apatitic and contains abundant mobile ions. These proto-bone materials evolve in solution toward stoichiometric apatite, which is shown to be more thermodynamically stable, but also less reactive. A key finding is that the growth, stability, and reactivity of nanocrystalline apatite are closely related to this "surface hydrated ionic domain", not quite solution, and certainly not crystalline, but more like an interphase on the nanocrystals that separates their apatitic core from the solution from which it precipitates.

Useful Mineral Links:

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



AFMS Code of Ethics



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

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

Family ~ \$25.00 per year. One address.

Individual ~ \$20.00 per year.

New * Renewal Dues are for Year _____ *

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

ANNUAL DUES – PLEASE PAY YOUR DUES PROMPTLY.

Pay at next meeting or mail to:

Mineralogical Society of DC
c/o John Weidner
7099 Game Lord Drive
Springfield, VA 22153-1312

Name(s) (First and Last) _____

Address _____

City _____ State _____ Zip: _____

Phone(s): Home/Work/Mobile _____

Email(s): _____

OK TO INCLUDE YOU ON CLUB MEMBERSHIP LIST?

Yes – Include name, address, phone, email.

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

Omit my: Email; Home phone; Work phone; Mobile phone; Address; Name

SPECIAL CLUB-RELATED INTERESTS? _____

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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