# Granite State Geologist

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**In this issue:**



## MESSAGE FROM THE PRESIDENT

I really enjoyed the January meeting. Lots of fun and I won a nice raffle prize: a pyrite ball. Buying an extra set of tickets paid off when the middle ticket won. And, the money raised goes to our grants programs that support equipment and supplies for classroom education. Let me know if your school is interested in our grant program.

I've got to admit to a new addiction: the NH Geological Survey's website for mapping stone walls on LiDAR imagery. The website features an airphoto base map that can be stacked with LiDAR imagery and with coverages of stone walls posted by the people who live there. Zooming in and out of areas that I know and looking where people have identified stone walls is just fun! A lot of areas are still unmarked, but have wall-like features waiting to be added. The shear density of stone walls in those areas where they are mapped is astounding and the other features visible in the coverages kept me scrolling around the countryside. Access to the online map is available in this newsletter.

Save the April 3 date for the NH Geological Survey's Mappers' workshop at DES. Gilsum Rock Swap and Mineral Show will be the weekend of June 22-23. Our summer field trip is in the making. Still up in the air, but it seems likely that we will be looking at the geology of the Pawtuckaway ring dike and the history of operations at nearby Pawtuckaway Lake. Keep an eye on the website because the trip may be much earlier (say June) than in previous years, or in late August. Plans are still under development.

With mixed feelings, I am pleased and relieved, and only a little nostalgic in announcing that there will be a new newsletter editor, Jenny Lambert, starting next issue. Jenny was recently elected to the Board as a Member-at-Large and volunteered to step up and take on the newsletter editor position. I started as editor thirty issues ago for the December 2011 edition, so I'm looking forward to being surprised when I turn the pages and read the articles in future editions!

## NH DES CALLS FOR LOWER LIMITS ON ARSENIC IN DRINKING WATER

Edited from Ken Liebeskind - The Telegraph Jan 14, 2019
http://www.nashuatelegraph.com/news/local-news/2019/01/14/des-calls-for-lower-limits-on-arsenic-in-drinking-water/ On Jan. 2, the Department of Environmental Services turned its attention to arsenic, recommending a more protective limit for the level of arsenic in drinking water that is provided by public water systems. On Jan. 4, DES proposed a new limit of 5 parts per billion, after enforcing a limit of 10 ppb since 2006 that was established by the EPA.

Arsenic occurs naturally in various rock formations, including some that are quite common in New Hampshire. “It’s primarily naturally occurring, rather than from human activity and is found in the bedrock,” said Paul Susca, a supervisor of the drinking water program at DES. “Public or private wells are most likely to be affected, with shallow wells and surface water sources less likely.”

Reducing the parts per billion (ppb) level of arsenic can reduce instances of cancer and other diseases that can be caused by consumption of water with a higher level of arsenic. Risks of lung, bladder and skin cancer, cardiovascular disease and other ailments, including adverse birth outcomes, illnesses in infants and reduced IQ can be reduced by lowering the level of arsenic from 10 to 5 ppb, according to a DES report.

On June 8, 2018 Gov. Sununu approved HB 1592, which requires the DES to review the groundwater standard for arsenic to determine whether it should be lowered. DES plans to work with the Legislature to lower the drinking and groundwater standards for arsenic, which will alleviate adverse health impacts from arsenic contamination. It also analyzed the cost of water treatment to remove arsenic.

Rep. Chuck Grassie has initiated a new bill. Grassie, D-Strafford, said HB 261 “keeps the fire going. We knew 5 ppb would be the standard that can be supported scientifically and financially.”

The cost of implementing the 5 ppb level would cost $1 million initially and $4 million per year for most of the 300 public water systems in the state that use an absorption system for removing arsenic, Susca said. The additional cost comes from the need to replace the devices that filter the water. About 200 public water systems currently have an absorption device, while 123 would need to purchase it. “They would have capital and annual costs,” Susca added.

Private well owners, who are not required by the state to adhere to clean water regulations, may wish to remove arsenic from their water. “Private well owners would use similar technology, but on a smaller scale,” Susca said. “They could use a point of entry system to protect their entire house or a point of use system under the sink, which is more affordable and would range from a few hundred to a thousand dollars.”

A study conducted by Dartmouth College in 2014 estimated that some private well users would voluntarily incur costs to insure their drinking water meets health-based standards. If all of the 37,459 households with private wells installed point of entry systems at a cost of $3,000 per home, the cost would by $112 million. If they installed point-of-entry systems at $1,500 per building the cost would be $56 million.

The state plans to set a lower level for arsenic before the EPA does. “The federal standard has been 10 ppb since 2001 and we’ve been implementing it since 2006,” Susca said. “Since then there has been additional research on the health effects of arsenic and we reviewed that data. The EPA may revise federal standards after they review it, but in the meantime we revised the level after studying information on cardiovascular disease and other adverse health impacts arsenic can cause.”

While the DES has acted on arsenic before the EPA has set federal standards, Grassie said, “There is a little disappointment, because all the DES is doing is following the federal government lead. We applaud them for taking action but we may want to file new legislation after we take a look at the impact the chemicals have in New Hampshire so public water is safe.”

The DES report on the arsenic issue can be viewed here:
https://www.des.nh.gov/organization/commissioner/pip/publications/documents/r-wd-18-20.pdf

## NORWAY'S MELTING ICE IS REVEALING PRICELESS ANCIENT ARTIFACTS

Items thousands of years old have been discovered in the wake of receding mountain ice.
Michael d'Estries January 27, 2018

**An iron arrowhead, possibly dating back a millennium or more, emerging from an ice patch in the mountains of Norway. (Photo: Secrets of the Ice/Oppland County Council)**

Read more at: https://www.mnn.com/earth-matters/climate-weather/blogs/ancient-artifacts-are-emerging-norways-melting-ice

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**3000-YEAR-OLD TREES EXCAVATED UNDER GLACIER** By Iceland Review December 4, 2017 https://www.icelandreview.com/news/3000-year-old-trees-excavated-under-glacier/

Ancient tree stumps found under Breiðamerkurjökull glacier in Southeast Iceland are confirmed to be roughly 3,000 years old. A specialist believes the remarkably well-preserved stumps were part of a massive forest that disappeared after a long period of a warm climate.

One of the tree stumps was found in Breiðamerkursandur a couple of months ago, and once it was being salvaged a second, larger one was found. The smaller one was sent for examination while the larger will be examined at a later time. Examinations revealed that the tree stump died very quickly at 89-years-old in the month of June. Nearby sediments and data suggest that the glacier itself was the culprit.

The tree stumps are from a period when Iceland was covered in forests. Even though 9th century Norse settlers reported vast forests across the country, it is believed that 3,000 years ago, the forests were much larger, even reaching the highlands. Approximately 500 BC, the climate became colder and glaciers began to form, destroying parts of the forests.

The 3,000-year-old remains of the forest are very well preserved and will be researched thoroughly. "It is absolutely incredible just how well preserved this tree stump is, having been buried under a glacier and that it still looks so whole, as opposed to being all wrinkled up like many of the specimens we have found." Once examinations conclude, the water will be extracted from the tree stump and it will be filled with wax instead, allowing it to be exhibited. RÚV reports at http://www.ruv.is/frett/drumburinn-3000-ara-gamall-og-fell-i-skyndi.

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**RECAP OF JANUARY GSNH DINNER MEETING** by Wayne Ives

January's meeting was very informative. Muriel Robinette gave an update from the Professional Licensing Board and described ASBOG (Association of State Boards of Geology – responsible for writing/grading of the Fundamentals and Professional Geologists exams. Her message is later in this newsletter. Rick Chormann described NHGS's new program initiated in January to map the locations of stone walls in the state using LiDAR and personal site knowledge. Tom Fargo updated the assembly on relevant legislation being proposed in the NH legislature. And our presenter, Michelle Fame, professor at Castleton University, built a compelling case for different erosion rates between the top of Mount Washington and the lower elevations based on age dating. Dr. Fame first presented current day examples of glacial settings where both enhanced erosion and protected settings occur. After establishing that average erosion rates were very slow over the last 100 million year, the beryllium dating showed variable erosion rates under more recent (tens to hundred thousand years) conditions where mountain tops were less eroded than the lower elevations.

**After her brilliant presentation, Dr. Michelle Fame enjoys her speaker appreciation gift with Wayne Ives at the January 17, 2019 GSNH dinner meeting at Makris Lobster House.**

There were abundant intriguing raffle prizes at the meeting: 1st prize, won by Helen Mango, was a copy of Rocks and Minerals Magazine, v.92, #6 on the subject of NH topaz. Wayne Ives won 2nd prize of a globe of pyrite. The third prize of a child's mineral collection was taken home by Anne Sheehan. And 4th prize, a chunk of smithsonite from New Mexico was taken home by Will Orfei.

## NH MINERAL SPECIES: XENOTIME-(Y)

Xenotime-(Y) is a minor accessory mineral in both acidic and alkalic igneous rocks and their pegmatites. From the Greek xenos - "foreign" and time - "honor." The N. Sugarloaf Mtn. xenotime-Y was identified by EDS analysis by Dr. Eugene Foord on specimens provided by Bob Janules and Scott Whittemore for their article in the July/August 1990 issue of *Rocks & Minerals.*

**Xenotime-(Y) specimen from N. Sugarloaf Mtn., Bethlehem, NH**

Specimen Size: 0.6 mm pale orange crystal
Empirical formula: $Y(PO_4)$; Streak: White; Density: 4.4 - 5.1, Average = 4.75; Color: Yellowish brown, Greenish brown, Gray, Reddish brown, Brown; Crystal System: Tetragonal Ditetragonal Dipyramidal; Cleavage: {100} perfect; Molecular Weight = 183.88 gm; Dana class: Anhydrous Phosphates
https://www.mindatnh.org/New%20Gallery%20107.html
http://webmineral.com/data/Xenotime-(Y).shtml#.XH7FneTbKM8
http://webmineral.com/crystal/Tetragonal-DitetragonalDipyramidal.shtml#.XH7H_-TbKM8

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## FOSSIL SHARK TEETH FOUND WITH SUE THE T. REX ARE CLUES TO ECOSYSTEM

By Gemma Tarlach - January 21, 2019
http://blogs.discovermagazine.com/deadthings/2019/01/21/fossil-shark-teeth/#more-3197

Tiny fossil shark teeth trapped in the matrix — that's the matrix of rock and other material that once encased the world's most famous *T. rex* — represent a new species. The find is helping researchers recreate a Cretaceous environment that might not be what you'd expect.

***Sue the T. rex*** has called The Field Museum in Chicago home for nearly 20 years, and the iconic fossil is a huge draw for tourists and paleontologists alike. With more than 90 percent of it recovered, it's the most complete *T. rex* skeleton known, and the largest. Sue holds a wealth of scientific value, but the fossil's significance goes beyond the bones themselves.

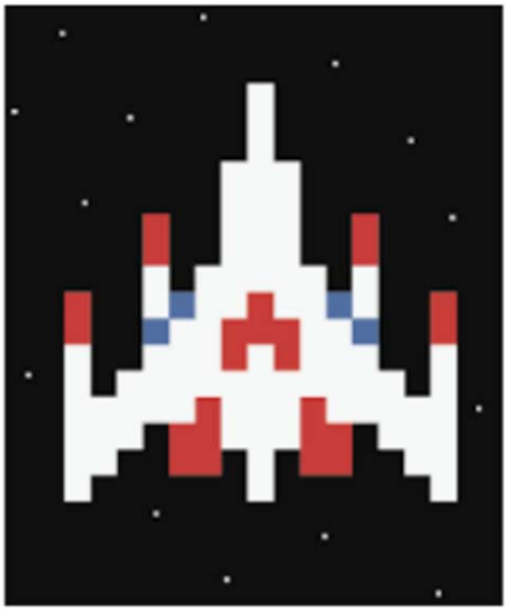
**Fossil shark teeth found near the famous *T. rex* known as Sue led to the identification of new species *Galagadon nordquistae*, shown here in an artist rendering. *(Credit: Velizar Simeonovski/The Field Museum)***

Prepping the specimen for display required thousands of hours of careful work separating the dinosaur from about two tons of surrounding sedimentary rock, known as matrix. And in that rock were other fossils, perhaps not as impressive as Sue but important for understanding the stomping grounds of the massive predator roughly 66 million years ago.

**Sue the *T. rex*, pride of Chicago's Field Museum, was relocated in 2018 to a better show off the animal's impressive 40-foot-plus length. *(Credit: The Field Museum)***

Field Museum volunteer Karen Nordquist, patiently picking through matrix leftover from preparing Sue, found more than two dozen tiny fossil shark teeth, each about as wide as the head of a pin. Paleontologists identified the teensy teeth as belonging to a new species, *Galagadon nordquisti*. In addition to honoring Nordquist, the name is a nod to the old school arcade game Galaga, which featured spaceships with a shape similar to the shark teeth.

**Tooth of Galagadon nordquisti.** ***(Credit: Terry Gates)***



**The Galaga spaceship**

Because shark skeletons are made of cartilage, nothing of the animal remained other than its teeth. By their size, however, the team was able to determine that Galagadon would have been about two feet long — a mere fun-size snack for Sue, if the carnivorous dinosaur had ever developed a hankering for fish.

**Requiem For A Tooth -** In addition to new shark Galagadon, the matrix surrounding Sue also yielded fossils of other, previously known sharks, plus a single tooth from an undetermined species of requiem shark.

What's exciting about that tooth is that it's the first solid evidence of requiem sharks going all the way back to the Cretaceous Period. The requiem sharks are one of the largest shark families and today include bull sharks, tiger sharks and lemon sharks (plus about 50 other species), though the timing of their origin has long been debated.

All of these sharks would have been swimming in a river where Sue may have stopped for a drink. Finding such a diverse collection of the fish suggests that the animals occupied more diverse ecosystems than they do today: Only a handful of modern sharks spend time in freshwater environments.

During the Late Cretaceous, much of the middle of North America — including the part of South Dakota where Sue and Galagadon were found — was intermittently flooded with an interior seaway. The water would have provided a rich environment for sharks and related species.

At the time that Sue and the sharks died, the seaway waters were already in retreat, creating a wide coastal plain carved with slow-moving rivers, just like the one where Sue and the sharks were deposited.

The research appears today in the *Journal of Paleontology*.

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## A METEORITE HIT THE MOON DURING MONDAY'S TOTAL LUNAR ECLIPSE

By Chris Baraniuk 22 January 2019

Observers of Monday's lunar eclipse were blessed with the first known sighting of a meteorite impact during such an event.

The so-called "super wolf blood moon" was eagerly watched by millions of people around the world, mostly via live streaming video. During the eclipse, some people noticed a tiny flash, a brief yellow-white speck, popping up on the lunar surface during the online broadcasts.

One Reddit user raised the possibility that this was a meteorite impact and others scoured eclipse footage for evidence of the event. A flash is visible in at least three different videos.

**The meteorite impact caused a bright flash, indicated by the arrow - Jose M. Madiedo**

Jose Maria Madiedo at the University of Huelva in Spain has confirmed that the impact is genuine. For years, he and his colleagues have been hoping to observe a meteorite impact on the moon during a lunar eclipse, but the brightness of these events can make that very difficult – lunar meteorite impacts have been filmed before, but not during an eclipse.

On this occasion, Madiedo doubled the number of telescopes trained on different parts of the moon – from four to eight – in the hope of seeing an impact. "I had a feeling, this time will be the time it will happen," says Madiedo.

After the eclipse, software automatically pinpointed a flash in imagery recorded by several of his telescopes. This helps to confirm that the flashes seen by live stream-watchers were not just optical anomalies on camera sensors.

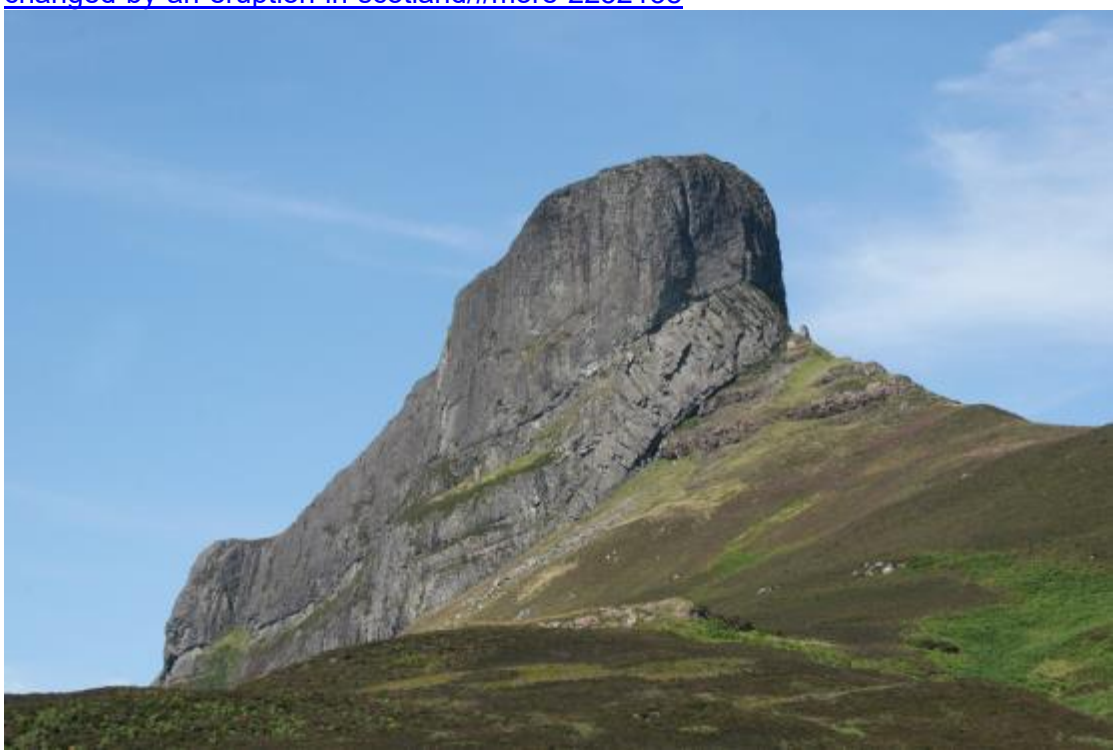
"I was really, really happy when this happened," says Madiedo. He notes that the flash was quite bright and it struck the moon at a moment when the eclipse was not overly luminous itself, perhaps making the strike easier to detect.

Although he has not yet formally calculated an estimate for the size of the space rock that collided with the moon, Madiedo thinks it probably had a mass of about 2 kilograms and was roughly the size of a football.

"The combination of a darkened surface and a lot of people watching made it much more likely that the flash of impact was seen – and it reminds us that the solar system is still a very dynamic place," says Robert Massey at the Royal Astronomical Society.

https://www.newscientist.com/article/2191526-a-meteorite-hit-the-moon-during-mondays-total-lunar-eclipse/

**COULD PAST GLOBAL CLIMATE HAVE BEEN CHANGED BY AN ERUPTION … IN SCOTLAND?** By Erik Klemetti | January 25, 2019
http://blogs.discovermagazine.com/rockyplanet/2019/01/25/could-past-global-climate-have-been-changed-by-an-eruption-in-scotland/#more-2252138



**Sgùrr of Eigg in Scotland, the location of some of the deposits of a massive explosive eruption in Scotland 56 million years ago. Flickr/Kevin Walsh.**

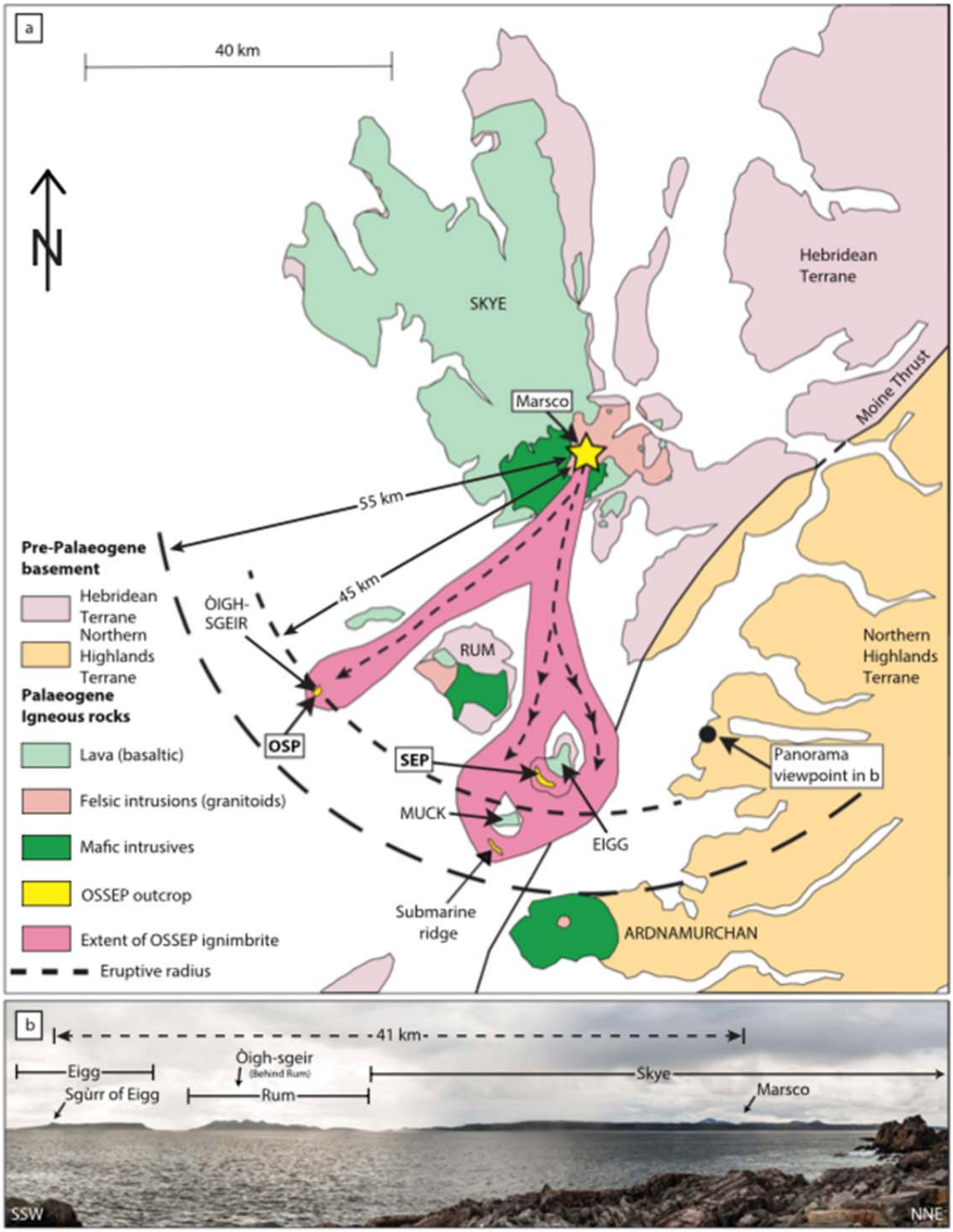
We don't tend to think of the British Isles as a land of volcanoes. However, over geologic timescales, things can be very different. ~50-60 million years ago, the North Atlantic Ocean was opening and the area around the modern North Sea was rife with volcanic activity. Much of these eruptions were lava flows, producing flood basalt provinces similar to the Columbia River Basalt — but now mainly under the waters and ice of the North Atlantic and Greenland. Yet, over in what is called the British Paleogene Igneous Province (BPIP) [https://www.geolsoc.org.uk/Plate-Tectonics/Chap4-Plate-Tectonics-of-the-UK/Tertiary-Volcanic-Province], there may have been massive, explosive eruptions that rivaled the largest eruptions of the past 500 years.

A lot of rock can be lost over ~56 million years. The effects of erosion, especially thanks to multiple pulses of rivers and ice sheets, can erase much of the evidence of even giant geologic events. Such is the case in Scotland, where the remnants of the volcanism are scattered across the landscape. Trying to match up pieces of volcanic material that are tens of kilometers apart can be tricky: do they represent a single, big eruption or many smaller eruptions (or possibly not even an eruption at all, but rather magma cooling underground!) The best ways to match these rocks is to look for clues in the composition and textures of the minerals and rocks.

If two areas have the same types of minerals that show similar sizes and shapes of those crystals, then maybe they are from the same event. If the bulk composition of the rocks match, that's even better. However, the processes of alteration of rocks by metamorphism or weathering can change bulk composition, so we need some even better evidence. That's when we turn to isotopes of elements like neodymium, strontium, oxygen, lead and more. Many of the elements aren't moved around by alteration, so they lock in the values of the processes that formed the rocks. So, match your isotope compositions, likely match your rocks.

That's what Valentin Troll and others did for some suspicious rocks in Scotland. They recently published a paper in Nature Scientific Reports that implicates an area on the Isle of Skye in Scotland for a massive volcanic eruption that might have been 5 to 6 on the Volcanic Explosivity Index. That would put it in with the aforementioned Pinatubo and Krakatau, disgorging

possibly 5 to 15 cubic kilometers of magma in a giant explosion. There isn't much left of this eruption beyond some units of pitchstone (think of an old, weathered, dark volcanic rock like obsidian), but several areas across northern Scotland appear to match in minerals, composition and isotopes — all signs they might be a single volcanic deposit.




Reconstruction of the potential pyroclastic flows from the Isle of Skye eruption 56 million years ago. From Valentin and others (2019), Nature Scientific Reports.

If this is the case, then an eruption ~56.7 million years ago in Scotland may have buried over 1000 square kilometers of countryside in ash and pyroclastic flow deposits. An eruption of this size would likely produce an ash plume that reached at least 40 kilometers, injecting volcanic aerosols like sulfur dioxide into the stratosphere. This would spread the material globally and potentially impact global climate.

Interestingly, there is a significant climate event around 55.5 million years ago called the Paleogene-Eocene Thermal Maximum (PETM) where global temperatures were high. Although this single eruption wouldn't have caused such an event (likely it cooled the climate for a few years), if you have lots of these events, it could tip the planet towards climate change. The evidence from places around the North Atlantic is that there were lots of big explosive eruptions related to the opening of the Atlantic, so maybe they played a role in the PETM transition.

Back to Scotland! The chunks of rocks that were evidence of an eruption can be matched using these composition and isotope tools to rocks that cooled underground on the Isle of Skye. This means that these intrusive rocks are likely the source of this massive eruption, implicating that some of the pyroclastic flows may have traveled up to 40 kilometers (see above) from the source! This new evidence from the Isle of Skye marks the first time a massive, explosive eruption has been identified and potentially sourced in the British Isles.

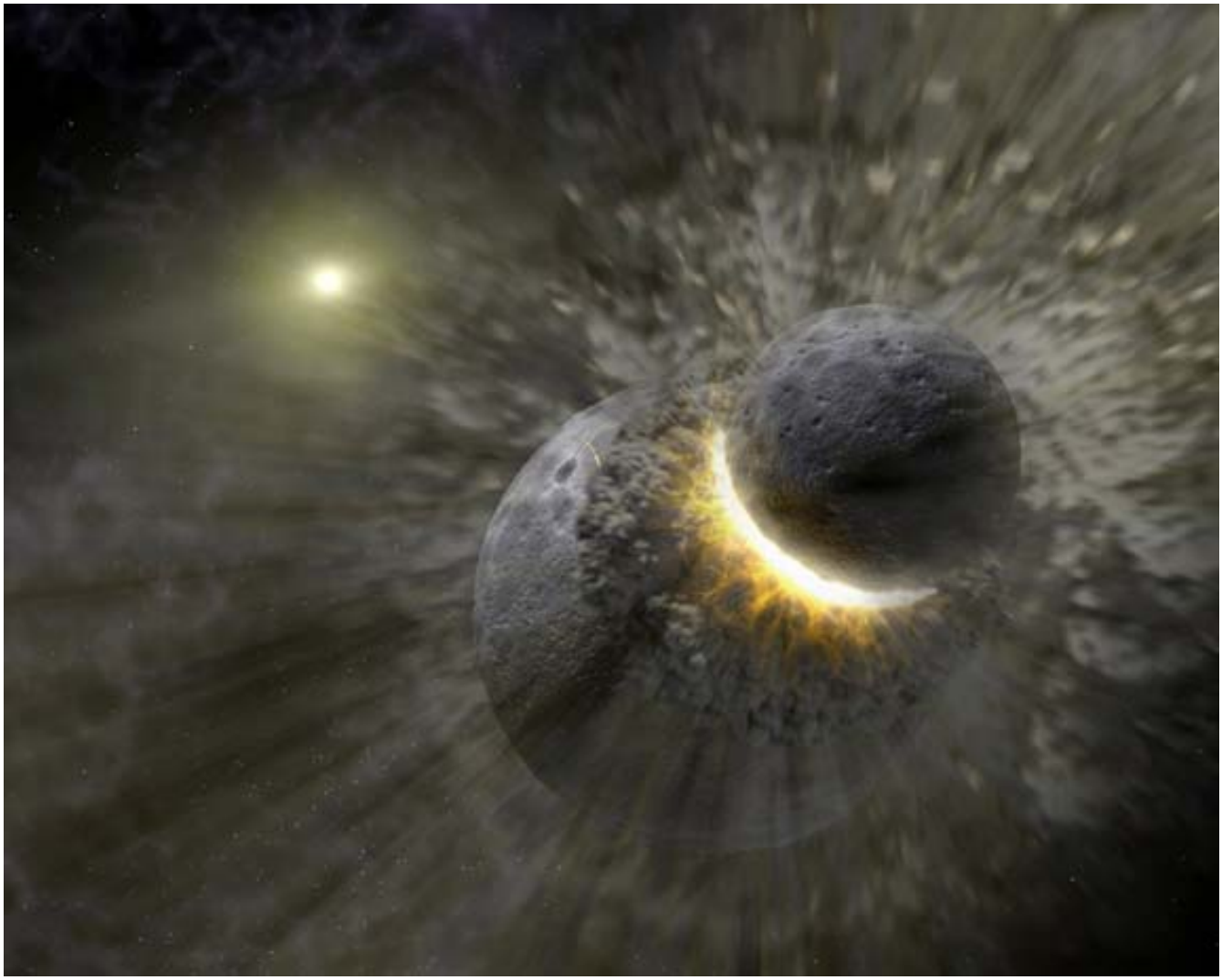
So, go back 56 million years ago, and what is now moors and mountains was a geologically-active region with volcanoes that may have rivaled some of the largest caldera volcanoes today. However, the endless reworking of the surface of the planet has erased the much of the evidence of even a gigantic and globally-significant event like the Isle of Skye eruption. It took the equivalent of volcanic forensics to piece together the scene of the blast.

## … AND THEN I SAW THIS INTERESTING ROCK FORMATION

**LIFE ON EARTH MAY HAVE BEEN MADE POSSIBLE BY AN ANCIENT, VIOLENT COLLISION** By Chelsea Gohd | January 24, 2019 5:08 pm

**Life on Earth** - Did the violent, cosmic collision that created the moon make life on Earth possible? One new study suggests so.

There are a number of theories for how life originated on Earth, many of which try to explain how our planet got the ingredients for life: elements like carbon and nitrogen.



**This artistic visualization shows a planetary collision near the star Vega. One new study suggests that the Earth obtained the elements that sparked life from a collision between the proto-Earth and a Mars-sized body that also created the moon.** ***(Credit: NASA)***

Previously, scientists have suggested that meteorites delivered life-giving elements to Earth (https://www.smithsonianmag.com/science-nature/the-building-blocks-of-life-may-have-come-from-outer-space-3884354/). While the isotopic signatures of these elements on Earth match up with these objects, the ratio of carbon to nitrogen isn't quite right. While the meteorites thought to have delivered elements crucial to life to Earth (known as carbonaceous chondrites) have 20 parts carbon for each part nitrogen, that ratio is about 40-1 on Earth.

Instead, these crucial elements may have been delivered in a staggering collision, says a group of petrologists at Rice University. Scientists know that a long-ago collision between the proto-Earth and a Mars-sized object created the moon — that same impactor may have also given us the elements for sparking life, they say.

## AN ANCIENT, VIOLENT COLLISION (continued)

To come to this conclusion, the research team created a simulation of the event based on a series of experiments that tested the behavior of carbon, nitrogen, and sulfur during the process of core formation on a rocky planet. The team then simulated the high pressures and temperatures during core formation and estimated how much carbon or nitrogen might be in a Mars-sized planet with a sulfur-rich core. They ended up with a geochemical simulation that accurately modeled observations of carbon, nitrogen and sulfur on Earth.

**A Probable Scenario -** With their simulation, along with the known ratios and concentrations of elements on Earth, the team found that instead of a rain of meteorites delivering crucial elements, a more likely explanation is that they came all at once.

"Our simulation results suggested that the most probable scenario of the origin of carbon, nitrogen, and sulfur on the silicate portion of Earth is where these elements are brought by a Mars-sized (8-10 percent by mass of the present-day Earth) planet merging with the proto-Earth," says Rajdeep Dasgupta, co-author of the paper in an email. Additionally, such a planet would probably have had a core rich in sulfur.

The work doesn't solve the question of how life originated on Earth, but it does begin to answer the question of how the ingredients for life might have gotten here. "There are many unanswered questions about how life truly originated. Our study, however, provides a mechanism to bring the raw materials needed for life's recipe," Dasgupta said.

This work is published in the journal Science Advances.
at http://advances.sciencemag.org/content/5/1/eaau3669 and
http://blogs.discovermagazine.com/d-brief/2019/01/24/collision-proto-earth-elements-life/#.XE8SWeTbKM8

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## GILSUM ROCK SWAP AND MINERAL SHOW TO BE HELD JUNE 22-23, 2019

Gilsum, NH -- The town of Gilsum, located in the scenic Monadnock Region in southwestern NH, will once again host thousands of people from all over the U.S. who will attend the Gilsum Rock Swap and Mineral Show. Here more than 65 dealers, swappers, distributors, wholesalers, and collectors can buy, sell, or swap beryl, quartz crystals, semi-precious stones, and rocks and minerals of all sorts. Displays range from newly found specimens in the rough to fossils, prized collector's pieces and hand-crafted jewelry.

The event takes place at the Gilsum Elementary School grounds, Route 10 in Gilsum, just north of Keene, NH, and is about 2 hours from Boston. Show hours are 8:00 AM to 6:00 PM Saturday and 8:00 AM to 4:00 PM Sunday.

Mineral collector and geologist Nancy Swing returns again this year with an all-new presentation on Herkimer diamonds, how they form and where to find them in the Northeast. Join Nancy Saturday at 1:00 pm in the Gilsum Elementary School auditorium - and get a free specimen!

Gilsum's many mines operated until the 1940s and yielded feldspar, mica, and beryl. Most are now abandoned, although one, the Beauregard mine, is available to mineral clubs through prior arrangement. Today collectors prize other minerals such as beryl. Maps showing locations of local mines are available during the show.

Since the show's inception, the town of Gilsum has opened its doors for the event. Activities include a presentation on prospecting Saturday, daily pancake brunch, bake sale, book sale, a traditional Saturday night New England ham and bean supper with homemade pies and a chicken barbeque dinner Sunday afternoon.

Admission is free, although donations are graciously accepted. All proceeds go to youth recreation and community programs. For more information please contact Robert Mitchell at the Gilsum Recreation Committee, P.O. Box 76, Gilsum, NH, 03448; call 603-357-9636; or send e-mail to gilsumrocks@gmail.com.

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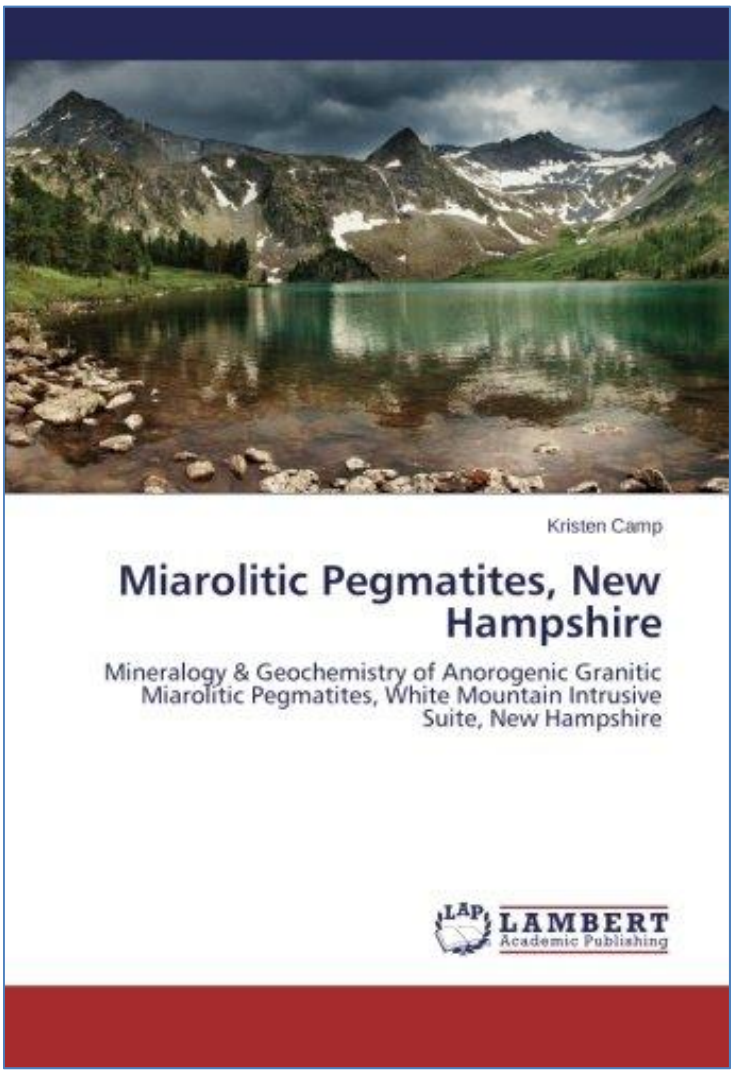
## MIAROLITIC PEGMATITES, NEW HAMPSHIRE: MINERALOGY & GEOCHEMISTRY OF ANOROGENIC GRANITIC MIAROLITIC PEGMATITES, WHITE MOUNTAIN INTRUSIVE SUITE, NEW HAMPSHIRE

Remember Kristen Camp who presented to the Society at our October 2011 dinner meeting. Well in 2012 her book came out in paperback. Here is a synopsis.




Subvolcanically emplaced granitic, miarolitic pegmatites associated with the White Mountain Igneous Province (WMIP), New Hampshire, were sampled and analyzed using modern analytical techniques including X-ray fluorescence, electron microprobe, scanning electron microscopy, and direct-coupled plasma spectrophotometry. Analytical results suggest that all the sampled miarolitic pegmatites from this study are petrogenetically related to the same intrusive suite, the WMIP. Based on the geochemical data, all the samples formed in an anorogenic tectonic setting and are rift-related. They are classified as NYF-type and plot in the —within plate granite field on tectonic discrimination diagrams. The majority of the samples are peraluminous, A1-type granites. The trace element abundances on the spider diagram and chondrite-normalized diagram, which include a pronounced negative Eu anomaly and REE enrichments, are consistent with these miarolitic pegmatites resulting from a strongly fractionated granitic parental melts, but less fractionated than the classic NYF-systems such as South Platte (Simmons et al. 1987) and the Wausau Syenite Complex (Meyers et al. 1984).

## GEOCHRONOLOGY AND THERMOCHRONOLOGY USING APATITE: TIME AND TEMPERATURE, LOWER CRUST TO SURFACE

Apatite can provide geologists with an exceptionally wide range of ages and temperatures to investigate processes that operate from Earth's surface right down to the lower crust. Apatite is a widespread accessory mineral in igneous, metamorphic, and clastic sedimentary rocks and can be dated using four radioactive decay schemes, each with a different temperature window for isotopic closure: Lu–Hf (675–750 °C); U–Pb (350–550 °C); apatite fission track (60–110 °C); (U–Th)/He (40–80 °C). The fission-track and (U–Th)/He methods are popular for studying upper-crustal and near-surface processes, whereas the U–Pb and Lu–Hf systems are used to investigate the thermal, tectonic, and magmatic histories of the deeper crust. Available at https://www.researchgate.net/publication/277902838_Geochronology_and_Thermochronology_Using_Apatite_Time_and_Temperature_Lower_Crust_to_Surface

## POST-ACCRETIONARY-EXHUMATION-OF-THE-MEGUMA-TERRANE-RELATIVE-TO-THE-AVALON-TERRANE-IN-THE-CANADIAN-APPALACHIANS

Apatite, a calcium phosphate mineral with the general formula $Ca_5(PO_4)3(F,Cl,OH)$, is prevalent in both magmatic and sedimentary rocks and can be generated and modified during metamorphic processes. This crustal ubiquity, along with its ability to host U, means that apatite has become useful in a range of geochronology and thermochronology applications (Chew and Spikings, 2015; Corfu and Stone, 1998; Kirkland et al., 2017; Mark et al., 2016; Schoene and Bowring, 2007;Weisberg et al., 2018). Thermochronology can be considered to date when a mineral passes through a specific closure temperature for the isotope of interest (Dodson, 1973) and is a consequence of the integrated passage of a mineral through a daughter isotopes partial retention zone.

Available at https://www.researchgate.net/publication/328310177_Post-accretionary_exhumation_of_the_Meguma_terrane_relative_to_the_Avalon_terrane_in_the_Canadian_Appalachians

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## DATES TO REMEMBER

April 3, 2019 – **NHGS Mappers Workshop** – SAVE THE DATE!

April 18, 2019 - **GSNH annual dinner meeting** at Puritan Restaurant in Manchester
"Fairbanks to Prudhoe Bay and Back" by Charlie Darling
The University of Alaska Fairbanks runs a Summer Session / Lifelong Learning field excursion every summer. Andover resident, Charlie Darling, a retired newspaper editor, was part of the 2018 session. The program lasts for 10 days traveling from the University of Alaska Fairbanks to Prudhoe Bay and back -- camping, coring the tundra, exploring pingoes, visiting the CRREL (Cold Regions Research and Engineering Laboratory) Permafrost Tunnel, fine dining at Toolik Field Station, touring the oil facilities at Prudhoe Bay, reading and discussing a dozen or more scientific papers, and much more. Charlie returned with many slides and a new appreciation of the complexity and importance of science in the Arctic.

May 12-15, 2019 – **2019 Geological Association of Canada Annual Meeting**, Quebec City Convention Center. Details at https://gac.ca/events/events-archive/gac-mac-annual-conference/.

May 31 to June 2, 2019 - Northeastern Friends of the Pleistocene, Cape Cod, Massachusetts http://www2.newpaltz.edu/fop/ Details in this newsletter.

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## WALLACE BROECKER, POPULARIZE THE TERM 'GLOBAL WARMING,' DIES AT 87

By Harrison Smith - Washington Post Feb 21, 2019

Wallace Broecker, a geochemist who issued warnings on global warming — a term he helped popularize in the 1970s — and later developed a model for how oceans circulate heat and affect climate, died Monday at a hospital in Manhattan at 87. As Broecker put it, “The climate system is an angry beast, and we are poking it with sticks.” Full story at:
https://www.unionleader.com/news/human_interest/wallace-broecker-who-helped-popularize-term-global-warming-dies-at/article_29bd788f-63a3-5585-a8f5-f2739fcf428a.html

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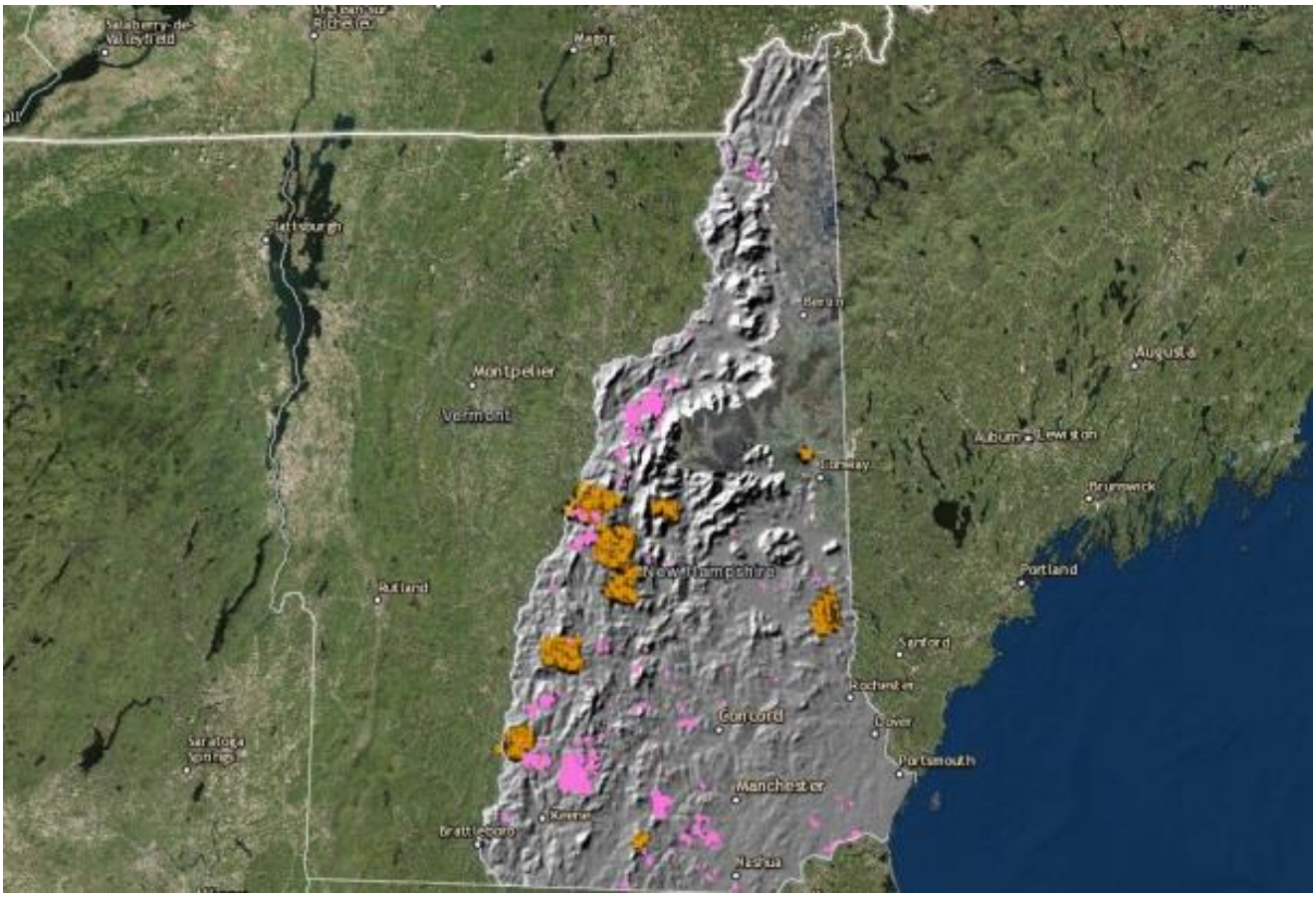
**NH STONE WALL MAPPER LAUNCHED** Thursday Jan 24, 2019

The NH Geological Survey (NHGS), at the NH Department of Environmental Services (NHDES), is launching a new interactive "New Hampshire Stone Wall Mapper" that will enable the public to use this online tool to map the state's historic stone walls. This crowd-sourcing map is made possible through a $14,487 grant from the NH Charitable Foundation. The grant will help further NHGS' mission to provide the public with information on the state's landforms and to promote earth science education.




**NH stone wall traces on a LiDAR basemap.**

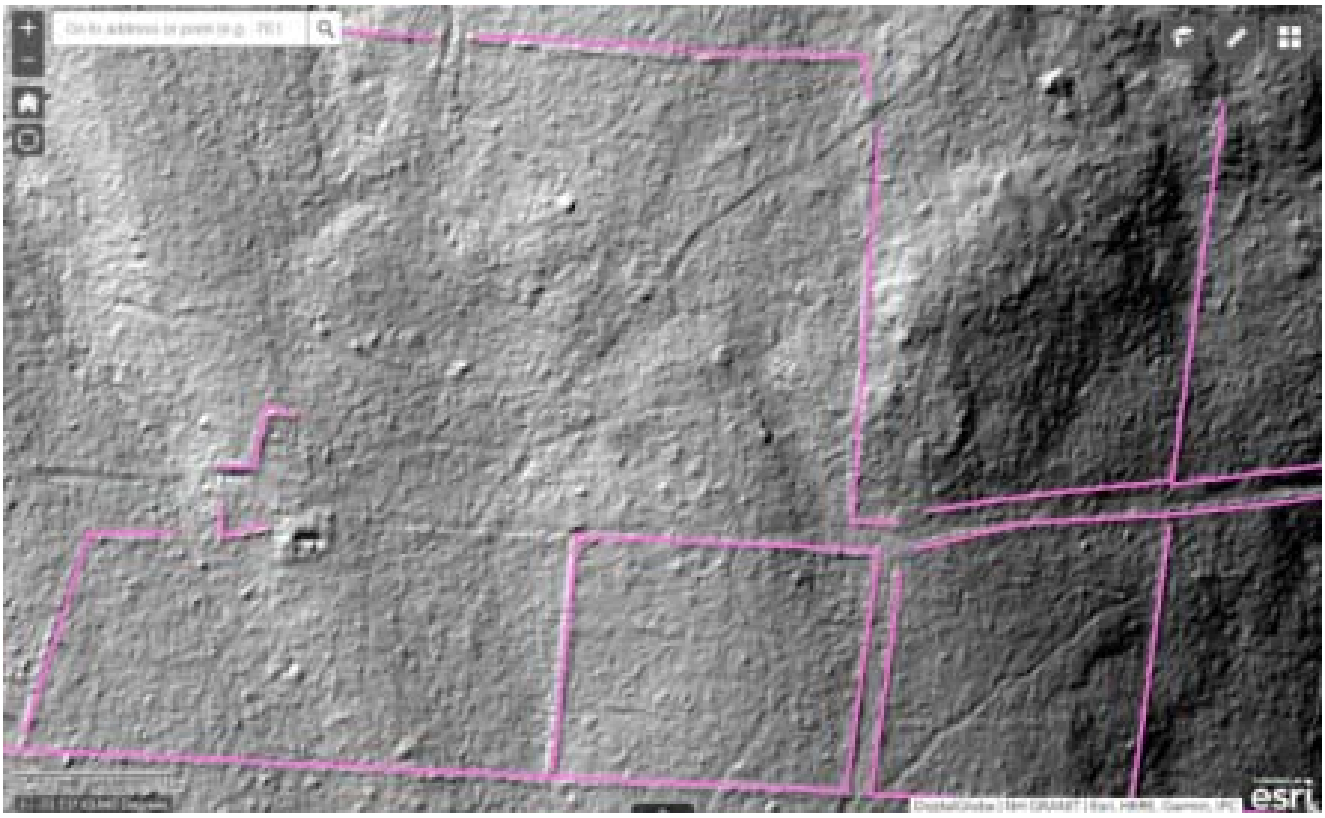
The New Hampshire Stone Wall Mapper uses Light Detection and Ranging (LiDAR) images across NH to map the stone walls, even in areas that are completely forested. LiDAR provides a detailed map of land surface elevations representing the "bare earth" as though treeless, rather than the aerial satellite imagery we are accustomed to. The NH Stone Wall Mapper provides an opportunity for the public to trace stone walls right onto LiDAR images while panning and zooming across the state on their computer screens. The mapping interface has been designed to be easy to use and only requires access to a web browser and the internet. UNH GRANIT developed and is hosting the crowdsourcing application.

According to Rick Chormann, NH State Geologist, the project is designed to stimulate the public's fascination with NH's legacy of stone wall building and help ensure their care and preservation. "We will fuse new technology with New Hampshire history to create a unique cultural heritage preservation asset and learning experience," says Chormann. "Over time we hope to build a network of volunteers mapping wall-to-wall across the entire state."

The project's maps of stone walls will provide an inventory that will support efforts by the state and local communities to monitor and preserve these iconic symbols of our heritage. New Hampshire state law affords limited protection to stone walls, but the provisions are weak and

**NH STONE WALL MAPPER (continued)**
enforcement is difficult. Insensitive repairs, removal or theft for resale elsewhere, road widening and new construction all take their toll on the state's stone walls.

"Generations of farmers and masons built thousands of miles of stone walls out of New Hampshire granite, and today those walls are vanishing," said Elizabeth H. Muzzey, director of the NH Division of Historical Resources and state historic preservation officer. "Identifying what remains is the important first step of preserving them for generations to come."




**Screenshot of stonewall traces outlining former fields on the LiDAR basemap.**

For links to the NH Stone Wall Mapper, as well as a companion website that details the history of stone walls and the use of LiDAR to reveal them, and guidance on how to interact on the map, please visit the Stone Wall Project webpage at www.granit.unh.edu/resourcelibrary/specialtopics/stonewalls. You can also join the community of stone wall mappers by becoming a member of the NH Stone Wall Mapping Project Facebook group: www.facebook.com/groups/NHstonewalls

For more information about the project, please contact Rick Chormann, state geologist and director, NH Geological Survey, at (603) 271-1975 or frederick.chormann@des.nh.gov.

https://www.eagletimes.com/news/stone-wall-mapping-project-uses-new-technology-to-honor-the/article_dba1b7d4-1910-11e9-a72c-43a5b873eb0d.html

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**WHAT'S YOUR BOARD BEEN DOING?** Submitted by Shane Csiki, Secretary March 2019

The last Board of Directors meeting was held on March 7, 2019, and was hosted by Nobis Engineering in Concord. At this meeting, and during meetings over the past year, the Board spent time discussing the continued implementation of "continuity of operations" plans. Among several tasks, this work includes setting up mechanisms so that Board members have central access to all of the same documents, such as Board minutes and other information. A key purpose of this work is to ensure seamless transitions in the future as Board members and positions change after biennial elections and to ensure retention of historical knowledge and transfer of such facts to

**WHAT'S YOUR BOARD BEEN DOING? (continued)**

future Board members. Member-at-Large Bill Abrahams-Dematte will be working to establish the framework for this in the coming months.

As noted elsewhere in this issue, this edition marks Wayne Ives' final newsletter that he is collating as editor. Wayne is passing the newsletter torch to new Member-at-Large Jenny Lambert, who will be the editor in our next edition.

Sharon Lewandowski and Lee Wilder continue their hard work in putting together our dinner meetings. They have been working with the Puritan in Manchester, the site of our April dinner meeting. Julie Spencer has thought about possible 2019 summer field trip ideas, which the Board discussed. A trip to Pawtuckaway State Park remains a possibility. Stay tuned for further details. All Board members have been considering ideas for potential speakers for the 2019-2020 dinner series. If you have an idea for a potential speaker, please reach out to any Board member.

These highlight but a few examples of the ongoing "behind the scenes" work of the Board.

The next GSNH Board meeting will be held on June 13, 2019, in Hopkinton, starting at 6:00 PM. All GSNH members are welcome to attend.


**NEWS FROM YOUR STATE LICENSING BOARD** from Muriel Robinette, ASBOG Chair, 2/25/19

New Hampshire's State Licensing Board is a member of the National Association of State Boards of Geology (ASBOG), along with 31 other Member Regulatory States (MRS). As such, your Board sometimes hears interesting geological licensing news from around the country, which we will pass on via the NHGS newsletter, on a periodic basis. News in 2019 is that your State Board is hosting ASBOG's national meeting of its Subject Matter Experts (SME). SMEs gather annually to write questions for the Fundamentals of Geology and the Practice of Geology exams, as well as vet the results of previously given exam questions. To help break up the headiness of writing exam questions, the SMEs take a field trip, which in 2019 will focus on the Geology of the Lakes Region, as organized by EGGI/GZA. Some of you may remember this field trip in 2013 when it was sponsored as NHGS Summer Field Trip. ASBOG is always looking for more volunteers to become SMEs, so if you are interested in being considered and serving our profession in this important way, please send in your resume to the Board and we will forward to ASBOG for their consideration. Contact info: Dawn Couture, (603) 271-0239 dawn.couture@oplc.nh.gov Web site: www.oplc.nh.gov/geologists.

## MEGHALAYAN AGE ANNOUNCED AS OFFICIAL NEW CHAPTER IN EARTH'S HISTORY

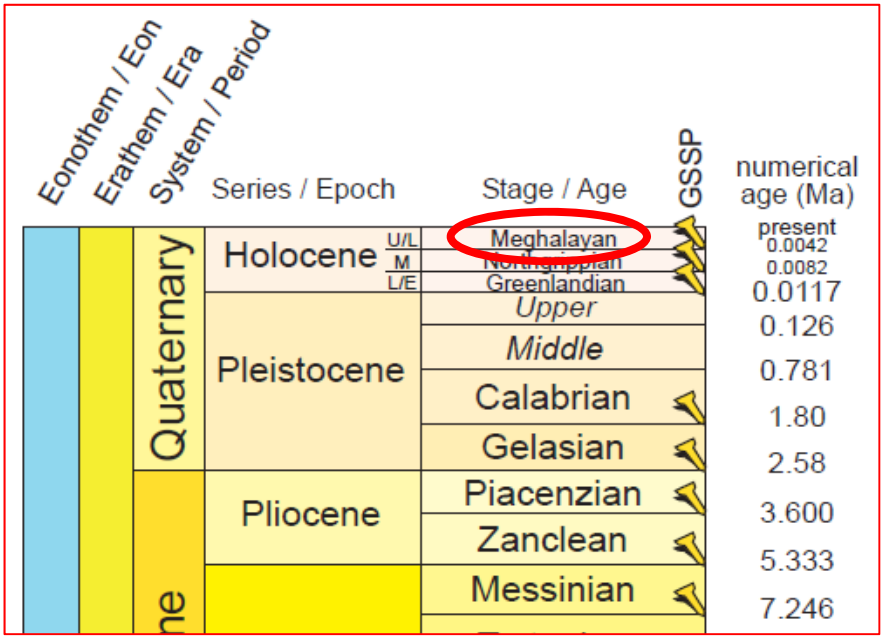
Josh Gabbatiss, Science Correspondent, 18 July 2018

[Edited from the original version at https://www.independent.co.uk/news/science/meghalayan-age-new-chapter-earth-history-geology-drought-anthropocene-a8452646.html - ed.]

**Newly described period began with enormous drought 4,200 years ago**

In a meeting held in June, the International Commission on Stratigraphy (ICS) announced the new division in time, which will now appear on all official charts depicting Earth's geological past.

Geologists use the International Chronostratigraphic Chart to show the divisions in the planet's 4.6 billion-year history, each of which is marked by major events like the break-up of continents or climate change. Every age is characterized by its global impact and a notable change in rocks and sediments.




The past 4,200 years have been officially classified as a new chapter in Earth's history – the Meghalayan Age.

The Executive Committee of the IUGS has now ratified the proposal submitted by ICS that subdivides the Holocene Series into the Greenlandian (11,700 yr b2k), Northgrippian (8326 yr b2k), and Meghalayan (4200 yr before 1950) stages, and that these stages correspond to the Lower, Middle and Upper Holocene subseries.

**International chronostratigraphic chart can be found at www.stratigraphy.org and Tweeted at https://twitter.com/theIUGS/status/1017837047548186624.**

The Meghalayan is unique because it is the first interval in Earth's geological history that has coincided with a major cultural event, as agricultural societies struggled to recover from the shift in climate. Beginning with a global drought that had devastating consequences for ancient civilizations from Egypt to China, the new age is the most recent section of a longer period known as the Holocene Epoch, which reflects everything that has happened over the past 11,700 years.

The concept of the Meghalayan was first proposed seven years ago due to specific chemical signatures found in stalactites and stalagmites. A stalagmite found in the north eastern Indian state of Meghalaya has provided the best evidence of this so far, and therefore gave its name to the new age. However, some researchers have objected to the Meghalaya's creation, especially as there are ongoing discussions about the definition of a new geological period based on human activity – the "Anthropocene." While the concept of an Anthropocene has been popularized in environmental circles as a symbol of the harm humans are causing to the planet, it too is a source of controversy. Many scientists have argued that while the name is eye-catching, it lacks the geological evidence to back it up.

Scientists like Professor Mark Maslin from University College London, who have been involved in the Anthropocene debate, have voiced their concerns about the abrupt imposition of this new age. "After the original paper and going through various committees, they've suddenly announced [the Meghalayan] and stuck it on the diagram," he told the BBC. "It's official, we're in a new age; who knew?"

## NEW CHAPTER IN EARTH'S HISTORY (continued)

Two other new phases within the Holocene – the Greenlandian and Northgrippian stages – were also identified based on ice cores sampled in Greenland, and together with the stalagmite they have been placed in protected archives for further study.


**Stalagmite from India showing the beginning of the Meghalayan Age (IUGS)**

A speleothem collected from the Mawmluh Cave, northern India, serves as the GSSP [Global Boundary Stratotype Section and Point see http://www.stratigraphy.org/gssp/ – ed.] for the Meghalayan Stage and will be curated in the Smithsonian Institution, Washington DC. http://www.stratigraphy.org/index.php/ics-news-and-meetings/120-ics-chart-containing-the-quaternary-gssps-and-new-stages-v-2018-07-is-now-released

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**THE NH GEOLOGICAL SURVEY GROUND WATER LEVEL NETWORK SUMMARY** Submitted by Josh Keeley of the NHGS

The data for all of the wells in the NH Groundwater Level Network are shared with and posted on the USGS website at: http://groundwaterwatch.usgs.gov/statemap.asp?sc=33&sa=NH. The NHGS posts its monthly groundwater levels from its network of NH Observation Wells online at: http://www.des.nh.gov/organization/commissioner/pip/publications/geologic/groundwater-levels.htm. A map of both the New Hampshire and Vermont Groundwater Level Network is at https://groundwaterwatch.usgs.gov/netmapT2L1.asp?ncd=NHV.

Groundwater Level Monitoring reports are available here https://www.des.nh.gov/organization/commissioner/pip/publications/geologic/groundwater-levels.htm

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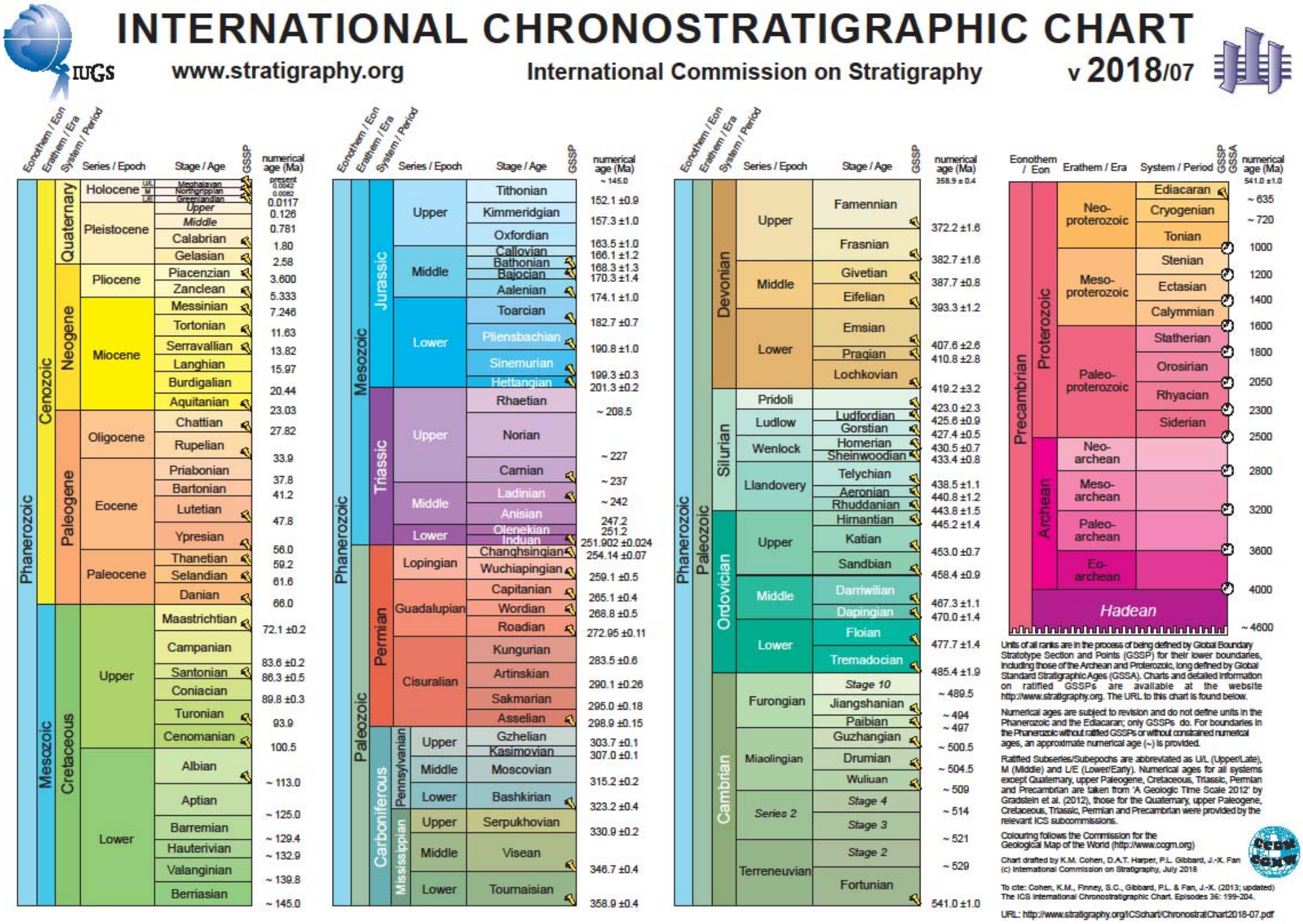
INTERNATIONAL CHRONOSTRATIGRAPHIC CHART
IUGS
www.stratigraphy.org
International Commission on Stratigraphy
v 2018/07
Eonothem / Eon
Erathem / Era
System / Period
Series / Epoch
Stage / Age
GSSP
numerical age (Ma)
Phanerozoic
Cenozoic
Quaternary
Neogene
Paleogene
Mesozoic
Cretaceous
Holocene
Meghalayan
Northgrippian
Greenlandian
Upper
Middle
Pleistocene
Calabrian
Gelasian
Pliocene
Piacenzian
Zanclean
Miocene
Messinian
Tortonian
Serravallian
Langhian
Burdigalian
Aquitanian
Oligocene
Chattian
Rupelian
Eocene
Priabonian
Bartonian
Lutetian
Ypresian
Paleocene
Thanetian
Selandian
Danian
Upper
Lower
Maastrichtian
Campanian
Santonian
Coniacian
Turonian
Cenomanian
Albian
Aptian
Barremian
Hauterivian
Valanginian
Berriasian
Paleozoic
Mesozoic
Jurassic
Triassic
Permian
Carboniferous
Pennsylvanian
Mississippian
Tithonian
Kimmeridgian
Oxfordian
Callovian
Bathonian
Bajocian
Aalenian
Toarcian
Pliensbachian
Sinemurian
Hettangian
Rhaetian
Norian
Carnian
Ladinian
Anisian
Olenekian
Induan
Lopingian
Guadalupian
Cisuralian
Changhsingian
Wuchiapingian
Capitanian
Wordian
Roadian
Kungurian
Artinskian
Sakmarian
Asselian
Gzhelian
Kasimovian
Moscovian
Bashkirian
Serpukhovian
Visean
Tournaisian
Devonian
Silurian
Ordovician
Cambrian
Famennian
Frasnian
Givetian
Eifelian
Emsian
Pragian
Lochkovian
Pridoli
Ludlow
Ludfordian
Gorstian
Wenlock
Homerian
Sheinwoodian
Llandovery
Telychian
Aeronian
Rhuddanian
Hirnantian
Katian
Sandbian
Darriwilian
Dapingian
Floian
Tremadocian
Furongian
Stage 10
Jiangshanian
Paibian
Miaolingian
Guzhangian
Drumian
Wuliuan
Series 2
Stage 4
Stage 3
Terreneuvian
Stage 2
Fortunian
Precambrian
Proterozoic
Archean
Neo-proterozoic
Meso-proterozoic
Paleo-proterozoic
Neo-archean
Meso-archean
Paleo-archean
Eo-archean
Hadean
Ediacaran
Cryogenian
Tonian
Stenian
Ectasian
Calymmian
Statherian
Orosirian
Rhyacian
Siderian
Units of all ranks are in the process of being defined by Global Boundary Stratotype Section and Points (GSSP) for their lower boundaries, including those of the Archean and Proterozoic, long defined by Global Standard Stratigraphic Ages (GSSA). Charts and detailed information on ratified GSSPs are available at the website http://www.stratigraphy.org. The URL to this chart is found below.
Numerical ages are subject to revision and do not define units in the Phanerozoic and the Ediacaran; only GSSPs do. For boundaries in the Phanerozoic without ratified GSSPs or without constrained numerical ages, an approximate numerical age (~) is provided.
Ratified Subseries/Subepochs are abbreviated as U/L (Upper/Late), M (Middle) and L/E (Lower/Early). Numerical ages for all systems except Quaternary, upper Paleogene, Cretaceous, Triassic, Permian and Precambrian are taken from 'A Geologic Time Scale 2012' by Gradstein et al. (2012), those for the Quaternary, upper Paleogene, Cretaceous, Triassic, Permian and Precambrian were provided by the relevant ICS subcommissions.
Colouring follows the Commission for the Geological Map of the World (http://www.cogm.org)
Chart drafted by K.M. Cohen, D.A.T. Harper, P.L. Gibbard, J.-X. Fan
(c) International Commission on Stratigraphy, July 2018
To cite: Cohen, K.M., Finney, S.C., Gibbard, P.L. & Fan, J.-X. (2013; updated) The ICS International Chronostratigraphic Chart. Episodes 36: 199-204.
URL: http://www.stratigraphy.org/ICSchart/ChronostratChart2018-07.pdf

## NORTHEASTERN FRIENDS OF THE PLEISTOCENE 2019 - FIRST ANNOUNCEMENT

The Northeastern Friends of the Pleistocene are returning to Cape Cod, Massachusetts, May 31 to June 2, 2019, sponsored by the U.S. Geological Survey, Massachusetts Geological Survey, and the Massachusetts Geological Society. Our headquarters hotel is the FOUR POINTS BY SHERATON EASTHAM with adjacent OCEAN PARK INN (please reserve rooms now – you may cancel easily if necessary). The annual banquet will be Saturday night, June 1 at the FOUR POINTS.

This trip comes 51 years after the original Cape Cod trip in 1968, led by Bob Oldale, Carl Koteff, and Joe Hartshorn, who invited the Friends to examine the geology shown on new, detailed geologic maps of the Cape Cod National Seashore. The present trip will visit classic stratigraphic localities that reveal evidence of meltwater processes active in construction of the large glaciodeltaic landforms of the outer Cape. We also will visit fresh pit exposures (your chance of a lifetime) in the two large recessional moraines and outwash deposits of the western Cape. Interpretation of offshore correlative geology from seismic profiles and origins also will be discussed. Holocene coastal and marine deposits of the Provincetown Hook, Wellfleet Harbor, and Seashore beaches will be visited. Our goal is to provide you with the latest stratigraphic framework of the Cape Cod area, a discussion of this part of the new Quaternary Geologic Map of Massachusetts, and opportunities for imaging and sampling typical sediments so that you are best prepared to teach these details to the next generation. The trip also features discussions about the bedrock surface beneath the Cape, distribution of Coastal Plain sediments on top of rock, history of subsurface studies, drill holes, ongoing contamination studies in aquifer zones, offshore geology, the last marine transgression, and developments in Quaternary geochronology of the area.

This trip covers parts of three days. Friends arriving early may enjoy sights and hikes early in the week at low off-season hotel rates. Trip activities will begin on FRIDAY at 10:00 AM when we will assemble at FOUR POINTS and drive to the first STOP on the outer Cape. We will visit STOPS in glacial and coastal deposits with scheduled assemblies at Seashore parking lots. A list of final STOPS and scheduled assembly times will be forwarded when we complete trip plans; you may join Friday's trip at a scheduled assembly point when you arrive during the day.

On SATURDAY, we board buses at the hotel and begin field stops in the Provincetown Spit, with discussion of offshore geology. We will then visit classic localities in the Wellfleet, Truro, and Eastham glaciodeltaic plains of glacial Lake Cape Cod, in order to consider a new twist on the setting of the earlier controversial Highland clay, to view details of various sedimentary facies, and to discuss relationships of these deposits to glaciotectonic Billingsgate deposits and the evolution of the glacial interlobate zone.

On SUNDAY, we rise early, settle with the hotel, and drive 45 minutes to park at the Cape Cod Canal visitor's center. There, we board buses for the trip to large pit exposures in the Buzzard's Bay and Sandwich moraines, and other exposures of outwash facies and postglacial deposits. The busses return to the parking lot at 2:00-3:00 so that you may begin your return trip from this vantage point.

Guests are responsible to make their own reservations (mention USGS Friends of the Pleistocene 2019 to receive the group rate). Reservations by attendees must be received on or before **05/01/2019 by 5pm.** Cancellation policies: Four Points- 48 Hours Prior to Arrival; Ocean Park Inn- One week Prior to Arrival

**FOUR POINTS BY SHERATON EASTHAM CAPE COD** **508-255-5000** reservations

Room Rates: May 31-June 3, 2019 Friday and Saturday, Per Night

Poolside Rooms with two queen beds: $169.00 Per Room; Larger rooms with two queen beds: $189.00 Per Room

**OCEAN PARK INN CAPE COD** **(**pet friendly) **508-255-1132** reservations

Room Rates: May 31-June 3, 2019 Friday and Saturday, Per Night

Rooms with two double beds: $109.00 Per Room; Rooms with two queen beds: $119.00 Per Room

Room rates Thursday night: $79.00 for rooms with 2 double beds and $89.00 for rooms with 2 queen beds

## ANCIENT FOREST THAWS FROM MELTING GLACIAL TOMB

By Laura Poppick, Live Science Contributor | September 20, 2013
https://www.livescience.com/6162-glaciers-melt-water.html

An ancient forest has thawed from under a melting glacier in Alaska and is now exposed to the world for the first time in more than 1,000 years.

Stumps and logs have been popping out from under southern Alaska's Mendenhall Glacier[1] — a 36.8-square-mile (95.3 square kilometers) river of ice flowing into a lake near Juneau — for nearly the past 50 years. However, just within the past year or so, researchers based at the University of Alaska Southeast in Juneau have noticed considerably more trees popping up, many in their original upright position and some still bearing roots and even a bit of bark, the Juneau Empire first reported last week.

**Environmental engineer Michael Nassry studies glacial streams from melting glaciers in Alaska. This shot shows new forests above the shrinking Mendenhall Glacier. It's rare to see a developing forest above a glacier. This picture highlights how these landscapes are rapidly changing.** ***Credit: Durelle Scott, Virginia Tech.***

"There are a lot of them, and being in a growth position is exciting because we can see the outermost part of the tree and count back to see how old the tree was," Cathy Connor, a geology professor at the University of Alaska Southeast who was involved in the investigation, told LiveScience's OurAmazingPlanet. "Mostly, people find chunks of wood helter-skelter, but to see these intact upright is kind of cool."

The team has tentatively identified the trees as either spruce or hemlock, based on the diameter of the trunks and because these are the types of trees growing in the region today, Connor said, but the researchers still need to further assess the samples to verify the tree type.

A protective tomb of gravel likely encased the trees more than 1,000 years ago, when the glacier was advancing, Connor said, basing the date on radiocarbon ages of the newly revealed wood. As glaciers advance, Connor explained, they often emit summer meltwater streams that spew aprons of gravel beyond the glacier's edge.

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[1] https://www.livescience.com/6162-glaciers-melt-water.html When Glaciers Melt, What's in the Water?

A gravel layer about 4 to 5 feet (1.2 to 1.5 meters) high appears to have encased the trees before the glacier ultimately advanced enough to plow over them, snapping off limbs and preserving the stumps in an ice tomb.

Taku Glacier, located south of Juneau, is currently triggering this same process as it advances over a modern forest of cottonwood trees, offering the researchers a chance to observe the process in real time, Connor said.

Unlike the growing Taku Glacier, which accumulates snow at a high elevation and thus is well situated to grow, the lower-elevation Mendenhall Glacier has retreated by an average rate of about 170 feet (52 m) per year since 2005. This year's summer retreat has not yet been calculated, but the team expects it to be relatively high due to unusually warm summer temperatures, Connor said.

Glacial retreat worries many locals who are concerned about the threat of rising sea levels and loss of major freshwater sources that they rely on for drinking water. Anchorage, the state's most populated city, relies entirely on the retreating Eklutna Glacier for its drinking water.

**Researchers have collected pieces of wood to date using radiocarbon dating techniques, and have found that the forest is more than 1,000 years old.** ***Credit: Jamie Bradshaw***

Still, glacial retreat does offer an interesting opportunity to investigate well-preserved remnants of an ancient world. The team plans to return to the Mendenhall Glacier to dig through sediment in search of pine needles associated with the trees, along with other vegetation. They also plan to measure the growth bands of the trees to determine how old the trees were when they died.

"These are relict stories, and piecing them together with radiocarbon dating and stratigraphic work would help piece together the chapters of the story," Connor said.

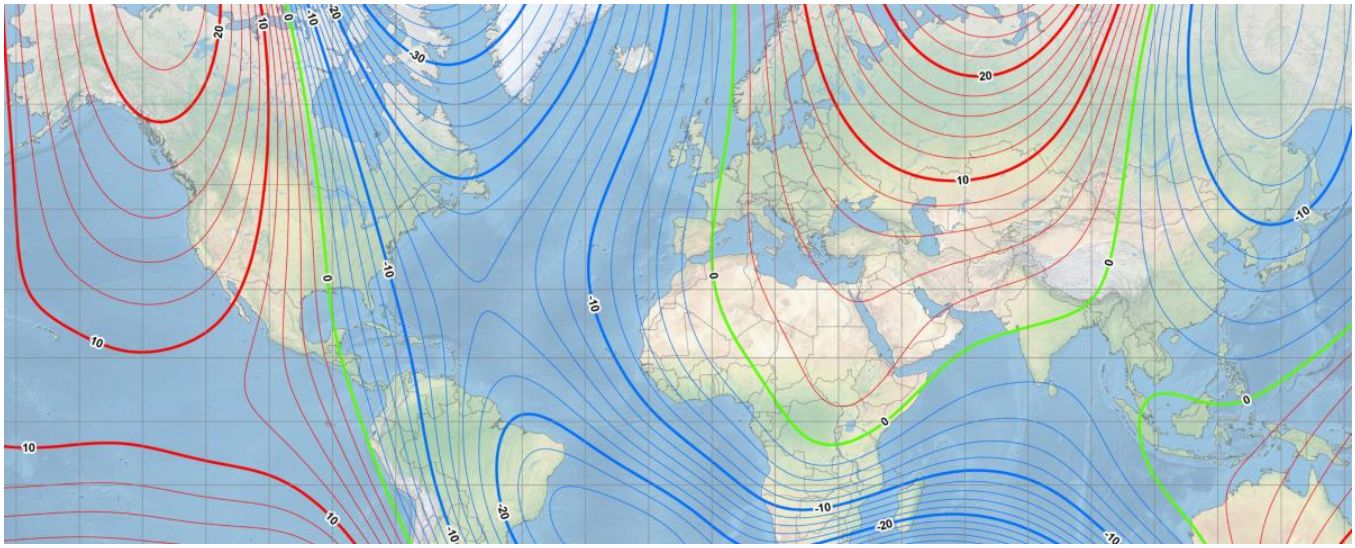
The researchers have not yet published the results from the investigation but plan to do so once they have gathered more data.

**WORLD MAGNETIC MODEL OUT-OF-CYCLE RELEASE** February 4, 2019 from NOAA NCEI

Earth's northern magnetic pole is moving quickly away from the Canadian Arctic toward Siberia. This movement has forced NCEI's scientists to update the World Magnetic Model (WMM) mid-cycle.

Typically, a new and updated version of the WMM is released every five years. With the last release in 2015, the next version is scheduled for release at the end of 2019. Due to unplanned variations in the Arctic region, scientists have released a new model to more accurately represent the change of the magnetic field between 2015 and now.

This out-of-cycle update before next year's official release of WMM2020 will ensure safe navigation for military applications, commercial airlines, search and rescue operations, and others operating around the North Pole.



**Uses of the WMM**

The military uses the WMM for undersea and aircraft navigation, parachute deployment, and more. Other governmental organizations, such as NASA, the Federal Aviation Administration, U.S. Forest Service, and many more use this technology for surveying and mapping, satellite/antenna tracking, and air traffic management.

Smartphone and consumer electronics companies also rely on the WMM to provide consumers with accurate compass apps, maps, and GPS services.

Airport runways are perhaps the most visible example of a navigation aid updated to match shifts in Earth's magnetic field. Airports around the country use the data to give runways numerical names, which pilots refer to on the ground.

"The declination has changed just over 2.5 degrees over the past 22 years since Denver opened," Heath Montgomery, the international airport's former spokesperson, said after the last update.

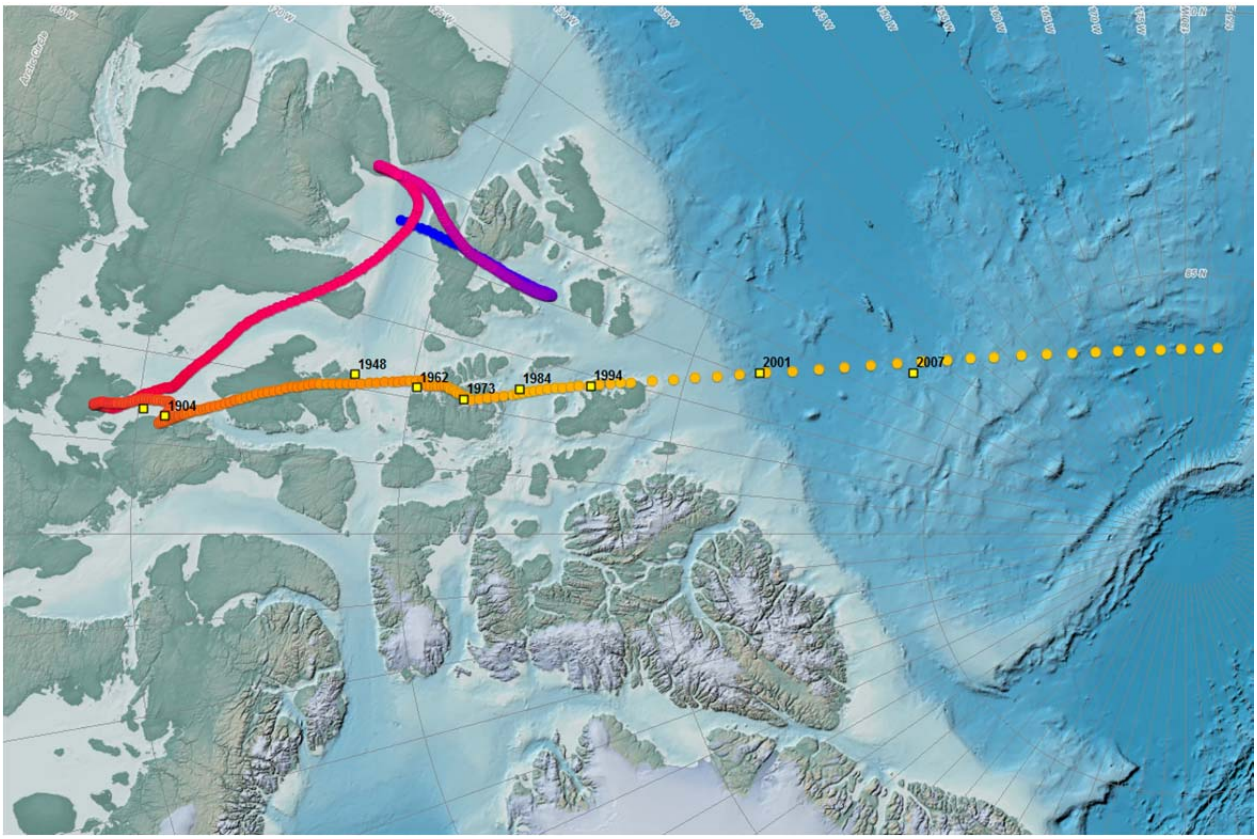
Compasses use declination (the difference between true north and where your compass points) to help correct navigation systems for a wide variety of uses. As Earth's magnetic field evolves between the 5-year release schedule of the WMM, these predicted values can become off as the rate of change in Earth's magnetic field evolves due to unpredictable flows in Earth's core. The north polar region is experiencing one of these erratic changes.

An animation showing changes in declination location and the "wandering" of the North Magnetic Pole over the last 50 years can be watched at http://geomag.colorado.edu/images/GIFS/Polar_Wander_1965.gif. Watch how the isogonic lines converge at the Pole. View historic data back to 1590 with our Map Viewer at https://maps.ngdc.noaa.gov/viewers/historical_declination/.

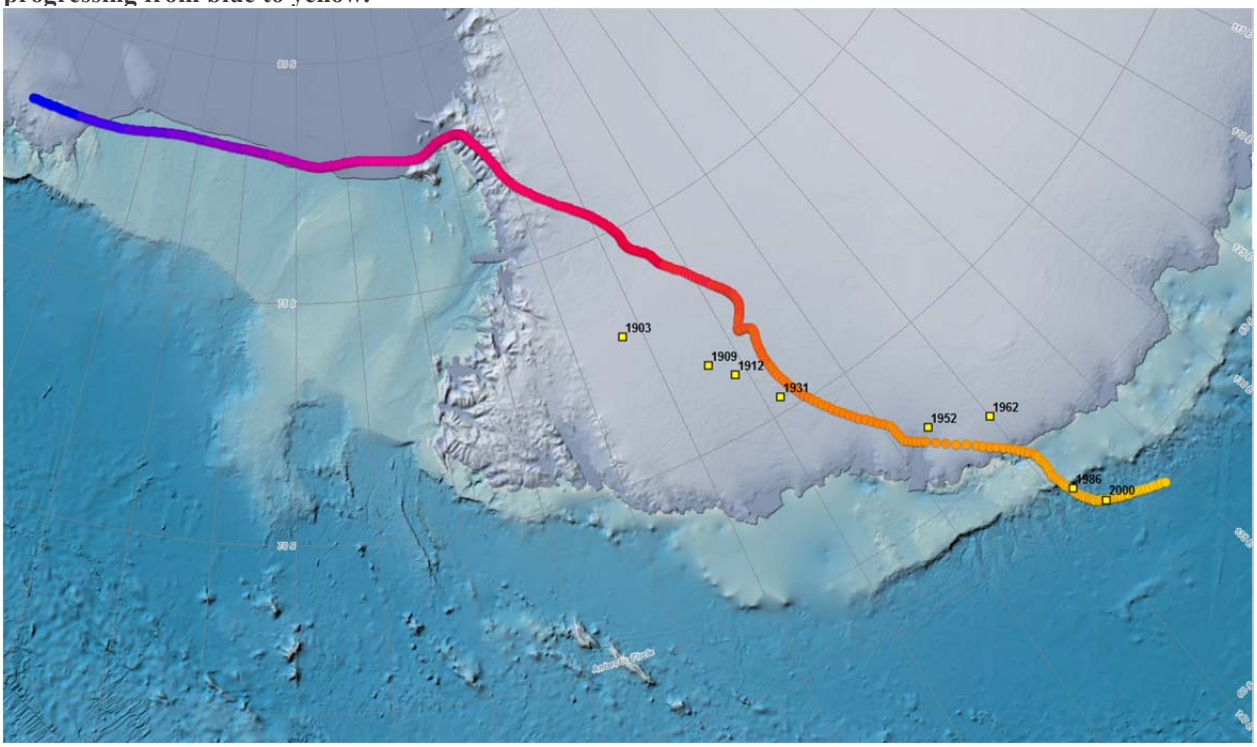
**Wandering of the Geomagnetic poles**

Magnetic poles are defined in different ways. They are commonly understood as positions on the Earth's surface where the geomagnetic field is vertical (i.e., perpendicular) to the ellipsoid. These north and south positions, called dip poles, do not need to be (and are not currently) antipodal. In principle the dip poles can be found by conducting a magnetic survey to determine where the field is vertical.

Other definitions of geomagnetic poles depend on the way the poles are computed from a geomagnetic model. In practice the geomagnetic field is vertical on oval-shaped loci traced on a daily basis, with considerable variation from one day to the next.




**Observed north dip poles during 1831 - 2007 are yellow squares. Modeled pole locations from 1590 to 2020 are circles progressing from blue to yellow.**




**Observed south dip poles during 1903 - 2000 are yellow squares. Modeled pole locations from 1590 to 2020 are circles progressing from blue to yellow.**

**Experimental observations of dip poles**

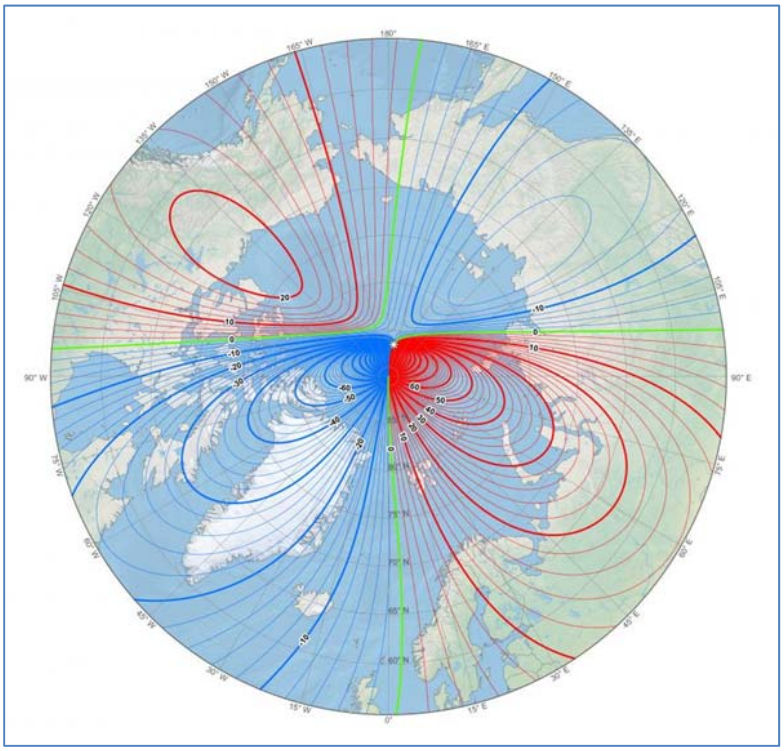
It has been long understood that dip poles migrate over time. In 1831, James Clark Ross located the north dip pole position in northern Canada. Natural Resources Canada (NRCan) tracked the North Magnetic Pole, which is slowly drifting across the Canadian Arctic, by periodically carrying out magnetic surveys to reestablish the Pole's location from 1948 to 1994. An international collaboration, led by a French fundraising association, Poly-Arctique, and involving NRCan, Institut de Physique du Globe de Paris and Bureau de Recherche Geologique et Miniere, added two locations of the North Magnetic Pole in 2001 and 2007. The most recent survey determined that the Pole is moving approximately north-northwest at 55 km per year.

A web based portal views both the experimental and modeled pole locations.

**Model derived geomagnetic poles**

Geomagnetic field models can also define ***geomagnetic poles***. The geomagnetic poles, or geocentric dipole, can be computed from the first three Gauss coefficients from a main field model, such as the World Magnetic Model (WMM) or International Geomagnetic Reference Field (IGRF). The WMM representation of the field includes a magnetic dipole at the center of the Earth. This dipole defines an axis that intersects the Earth's surface at two antipodal points called geomagnetic poles. Based on the WMM2015v2 coefficients for 2019.0 the geomagnetic north pole is at 72.69W longitude and 80.61N latitude, and the geomagnetic south pole is at 107.31E longitude and 80.61S latitude. The axis of the dipole is currently inclined at 9.45 to the Earth's rotation axis. The same dipole is the basis for the simple geomagnetic coordinate system of geomagnetic latitude and longitude. Scientists, map makers and polar explorers have an interest in the locations of the dip and geomagnetic poles. Although geomagnetic pole positions cannot be observed, they are arguably of greater significance than the dip poles because the auroral ovals (approximate 5 latitude bands where the spectacular aurora is likely visible) are closely centered on the geomagnetic poles. They are usually displaced slightly to the night-side of the geomagnetic poles and greatly vary in size: bands of greatest activity occur between 15 and 25 from the geomagnetic poles.

A software for computing the locations of geomagnetic pole is available here: https://www.ngdc.noaa.gov/geomag/geom_util/gmpole.shtml.



**This map shows the location of the north magnetic pole (white star) and the magnetic declination (contour interval 2 degrees) at the beginning of 2019. Courtesy of NOAA NCEI/CIRES.**

**Movement of magnetic poles from 1590 to 2020**

The ***magnetic poles or dip pole*** are computed from all the Gauss coefficients using an iterative method. Magnetic poles derived in this fashion are geographically closer to the experimentally observed poles. Based on the current WMM2015v2 model, the 2019 location of the north magnetic pole is 86.54°N and 170.88°E and the south magnetic pole is 64.13°S and 136.02°E.

From:
https://www.ncei.noaa.gov/news/world-magnetic-model-out-cycle-release
and
https://www.ngdc.noaa.gov/geomag/GeomagneticPoles.shtml.

# Geological Society of New Hampshire

## Topic: "Fairbanks to Prudhoe Bay and Back"
## Speaker: Charlie Darling

## Thursday, April 18, 2019
## Location: The Puritan - Pappas Room
## 245 Hooksett Rd, Manchester, NH 03104

## 5:30 pm Social Hour - 6:30 pm Dinner - 7:15 pm Speaker Presentation

**RSVP by 4 pm Friday, April 12, 2019 to get the reservation price**
SPACE AT THIS VENUE IS LIMITED T0 80...RESERVE EARLY!

Advance Reservations: _____Member (Dues Paid) $27.00
_____Non-member $30.00

- Students $10.00 with valid student ID card (Reservation Requested)
- Member at the Door $29.00
- Non-Member at the Door $32.00

**Checks payable to: GSNH.**

_____**Please indicate special food issues – leave blank for none.**

GSNH will also accept dinner reservations by e-mail, which will then allow you to pay at the door.
Reply via e-mail to: Sharon.Lewandowski@des.nh.gov or
Mail to: **Sharon Lewandowski , GSNH Dinner Meeting,**
**PO Box 401,**
**Concord, NH 03302**.

Please note that e-mail reservations constitute an agreement with the Society for which you will be responsible to pay, whether you are able to attend or not, unless you cancel your reservation by noon the Tuesday before the dinner.

Name(s) _____

Address: _____

Your phone or e-mail: _____

**The dinner and lecture program counts as 2.0 hours of CEU contact hour credit.**

MEMBERSHIP & RENEWAL APPLICATION

# Geological Society of New Hampshire

**PO Box 401, Concord, NH 03302**

**Name:** _____ *(Please print clearly)*

**E-mail:** _____

***Renewing Members**: Only update this section if you have changes to your contact information (including email) or educational history.*
***New applicants:** please complete this section.*

Preferred address/email to receive GSNH Communication: ___Home or ___Business

**Home Address**:

_____

_____

_____

**Business Address**:

(Employer): _____

_____

_____

Home Telephone: _____

Office Telephone: _____

New Hampshire PG # (if applicable) _____

**Education**: Degrees received or in progress:

| Year | Degree | Major | College or University |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

***I volunteer to help with one of the following committees or tasks:***

__ Membership Committee
__ Legislative Committee
__ Giving a talk at a meeting
__ *Regulations Committee*
__ *Education Committee*
__ Events Committee
__Communications Committee (Newsletter or Website, circle preference)
__ Other:

***Membership Category:***

_____ Regular Member (Annual Dues $20.00)

_____ Student Member (Annual Dues $10.00)…Please complete **Education** section above.

Make checks payable to **"Geological Society of New Hampshire."** Note that GSNH dues are not deductible as a charitable contribution, but may be deductible as a business expense. Please return this completed application form with any necessary corrections and a check for the appropriate dues to the GSNH at the address above. The Society's membership year runs from January 1 to December 31.

Signature: _____ Date: _____