# Granite State Geologist

**The Newsletter of the Geological Society of New Hampshire,**
**Winter Edition – December 2021 – Issue No. 115**
**Newsletter Editor:** jlambert@nobis-group.com **Website:** http://www.gsnh.org/



**In this issue:**



## MESSAGE FROM THE PRESIDENT

Many years ago, I was invited to participate in a "career day" in my daughter's sixth grade class (she's now 31 years old). To illustrate what geologists do, I dusted off my slide projector, pulled together a few slides of picturesque places I've been, and tried to describe through those slides how we live on a dynamic earth. I tried to convey that being a geologist, i.e., studying the earth's past and on-going processes, was a rewarding endeavor for someone who likes science and pre-history.

So what makes geologists different from other scientists? John McPhee, in his 1981 book "Basin and Range", makes many observations regarding what makes geologists special. If you haven't read this book, or haven't re-read it lately, I highly recommend picking it up over the holidays. It's likely to make you smile. In part, the book describes a trip across the US, along Interstate 80, juxtaposing contemporary observations of geologists with the geologic settings in which the observed rock features were formed. I started reading "Basin and Range" while heading east on I-80, between Laramie and Cheyenne Wyoming, returning with a group from the University of Buffalo "field camp". Coincidentally, I read the passage where McPhee describes the "gang plank" (a remnant of Tertiary deposits that provided Union Pacific Railroad with a natural transition between the high plains and Sherman Mountains summit) while I was on the gang plank.

Geologists, as a group, share the perspective of deep time. How we react to natural disasters (earthquakes, volcanic eruptions, floods, landslides) or predictions of catastrophes to

come (i.e., the loss of the cryosphere), is tempered with the realization that all this has happened before and inevitably will happen again. Another trait common to geologists is a highly developed proficiency in recognizing patterns; Which one of these is not like the other? or I saw that pattern somewhere else. Coupled with this can be a need to understand or speculate on how a particular geological feature formed. I call this the geologist's curse.

I personally cannot hike in the White Mountains and not think of the aluminosilicate phase diagram when I step on large sillimanite crystals in rocks along the trails. I cannot see steeply tilted layered rocks without wanting to stop to examine the outcrop for evidence of topping direction or bedding-cleavage intersections. A walk along the NH coast inevitably results in speculation regarding the rate of shoreline erosion and musings regarding what could or should be done to mitigate the impacts of rising sea level. Before I travel, I feel compelled to download geologic maps, USGS and State government publications detailing the geologic history of the places where I'm going, to get a basic understanding the geology and paleontology of the region. The geologist's curse is not limited to my direct observations. When I see mountain landscapes in travel videos, I cannot keep myself from speculating about the rock type is displayed and wonder about its age. Are those Precambrian, Paleozoic or Mesozoic granites? I'm cursed that I can't enjoy a scenic vista simply for its beauty. I have to over-analyze almost every feature on the face of the earth. Do you have this problem too? Perhaps I should start a support group.

I hope you have a great winter solstice holiday season. I can't wait for increasing daylight!

Tom

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## GSNH T-Shirts Available!

We have GSNH t-shirts available in size small, medium and large (sorry, sold out of extra large). T-shirts will be shipped to you – no need to wait until the next in-person meeting! See order form on second to last page (right before the renewal form).


**Front (left photo) and back (right photo) of GSNH t-shirt.**

## La Palma volcano has been erupting for 2 months

By EarthSky editors, November 19, 2021.
https://earthsky.org/earth/la-palma-volcano-lava-fills-swimming-pools-flows-through-streets/


**View at EarthSky Community Photos. | This image shows a fireball (a bit of space debris) from the Taurid meteor shower behind the La Palma volcano. From Roberto Porto.**

### La Palma volcano began erupting on September 19

It's been two months since a volcano on the Atlantic island of La Palma – part of Spain's Canary Islands – began to erupt on September 19, 2021. And the La Palma volcano is still erupting. According to the Smithsonian's Global Volcanism Program, as of November 16 the eruption at La Palma continues to be characterized by:

*… Strombolian explosions and lava fountaining from multiple vents, advancing and sometimes branching lava flows, and daily ash emissions.*

Almost two months after it began, the La Palma volcano claimed its first victim on November 13. According to reports from Spanish news wire EFE, a 70-year-old man was killed while working as a volunteer cleaning up volcanic ash when the roof of the building he was on collapsed.

On November 19 – the two-month anniversary of the start of the eruption – La Palma's volcano spewed a billowing cloud of gas and ash. Spain's National Geographic Institute said that the November 19 volcanic activity included a 5.1-magnitude earthquake, the strongest since eruptions began on September 19.

According to the Spanish news outlet El Pais on November 19, the eruption has forced about 7,000 people (of the 85,000 who live on La Palma) to evacuate. And the lava flow has covered over 1000 hectares (about 4 square miles), which is 1.4% of the total area of La Palma.

**Most destructive in living memory**

This volcano is widely regarded as the most destructive in La Palma's living memory. The lava flow is about 0.6 miles (1 km) wide and has reached the sea. According to 20minutos.es, the lava has destroyed more than 2,600 buildings, cut the coastal highway and formed a new peninsula.

The 2021 La Palma eruption is coming from Cumbre Vieja ("Old Peak"), considered to be one of the most active volcanos in the Canary Islands. Footage from local and international media shows the current eruption of red-hot lava and dust emanating from the Cumbre Vieja National Park in the south of the island. This volcano erupted twice in the 20th century, in 1949 and again in 1971. So, before the September 19 eruption began, the last eruption of this volcano on La Palma was 50 years ago. The 1971 eruption lasted just over three weeks.

See the images and video [links] [below]. Our thanks to EarthSky Community members Roberto Porto and Antonio Gonzalez, both of whom are on La Palma, and who contributed photos to our community page.

Video links:

- The Guardian: lava fills swimming pools as La Palma volcano eruption continues: https://youtu.be/9qDTTKumkQ0
- The Guardian: lava erupts from a volcano on La Palma in Spanish Canary Islands: https://youtu.be/EOIwjeJMNxM
- RTE News: lava pouring from the Canary Islands' first volcanic eruption in 50 years has forced authorities to evacuate another part of El Paso on the island of La Palma: https://youtu.be/-dbSaQbo-GU

Visit the as.com news site for live updates on the Cumbre Vieja volcano.

**View at EarthSky Community Photos. | Antonio Gonzalez in El Paso, La Palma Island, took this image of the volcanic eruption on November 14, 2021.**

**La Palma volcano, September 19, 2021, via Reuters.**

**Our friend Roberto Porto in La Palma captured this glorious panoramic photo on September 20, 2021. He wrote: "The new volcano in La Palma erupted and created this pyrocumulus illuminated by the full moon." Thank you for sharing, Roberto.**

**Also from Roberto Porto, who captioned this image from the same day: "The first night of the new volcano in La Palma." It's spectacular.**

## Armored Mud Balls and Mud Cracks in Southern Utah

From Earth Science Picture of the Day, September 27, 2021.
https://epod.usra.edu/blog/2021/09/armored-mud-balls-and-mud-cracks-in-southern-utah.html

The picture above features armored mud balls and soil cracking taken near the trailhead of the Wire Pass in Kane County, Utah. Armored mud balls are spherical soil formations composed of a mixture of silt, clay, sand, and gravel that form in stream beds or previously flooded areas. The diameter of mud balls usually ranges between 2 to 4 inches (5 to 10 cm), but it largely depends on the soil particles and gravel present. The size of the particles in a stream bed is directly related to the speed of the water. This means that when stream water slows down, larger particles like gravel and sand are deposited first, while smaller soil particles such as silt and clay can stay suspended in the water until the water is mostly stagnant. Sediments can be mud where flood water becomes stagnant, or pebbles deposited in a moderate current. As mud dries, it hardens and forms tessellated chunks caused by shrinking during desiccation.

Cracked pieces of soil may be dislodged by wind or water, while the mud is still wet below the surface. The pieces become round as they are pushed along the surface. Rolling balls of sticky mud can pick

up pebbles that “armor” them. These armored mud balls were found below the Buckskin Wash trailhead on the Utah-Arizona border. Mud balls can also be geologically preserved given the correct environmental conditions. Such examples include fossilized Triassic mud balls collected by Professor Richard Little, which are displayed in the Greenfield Community College Rock Park north of Amherst, Massachusetts.

Photo details: Olympus E-510: 42 mm, f/9, 1/250 second exposure, ISO-100

Kane County, Utah Coordinates: 37.019, -112.025

Related Links:

- Mudballs on the Beach
- Mud Cracks near Trona, California

Student Links:

- At Home Exercise – How Moist is that Mud?
- More Information About Mud Cracking

Earth Observatory: Possible Mud Cracks Preserved in Martian Rock

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## What’s Your Board Been Doing?

The big news since our last newsletter is that Shane Csiki, Secretary, has been appointed the New Hampshire State Geologist and Director of the New Hampshire Geological Survey (NHGS), as Rick Chormann is retiring. Unfortunately for us at GSNH, Shane determined that his new position at NHGS may represent a potential conflict of interest with his position on our Board and resigned as Secretary. His resignation took effect on October 14. For now the position of Secretary is TBD, but we are hoping to fill the position soon. We will miss Shane’s tireless dedication, and the Newsletter Editor will particularly miss his detailed and timely meeting updates for this newsletter! We wish him the best in his new role.

The GSNH Board met on Thursday, December 16. Other items discussed included updates on potential GSNH field hats (hopefully available for the Spring meeting and/or Summer field trip), digitizing old GNSH records, and plans for the next GSNH meeting, which will again be virtual. See Dates to Remember, page 21 of this newsletter, for details.

The next GSNH Board meeting is planned for March 10, 2022. We will see how the COVID situation pans out and determine whether this will be virtual or in-person as we get closer to March.

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## Meet the prehistoric eagle that ruled Australian forests 25 million years ago

By Trevor H. Worthy, Ellen K. Mather, Jacob C. Blokland, and Mike Lee, Flinders University, and Aaron Camens. From The Conversation, September 27, 2021.
https://theconversation.com/meet-the-prehistoric-eagle-that-ruled-australian-forests-25-million-years-ago-168249

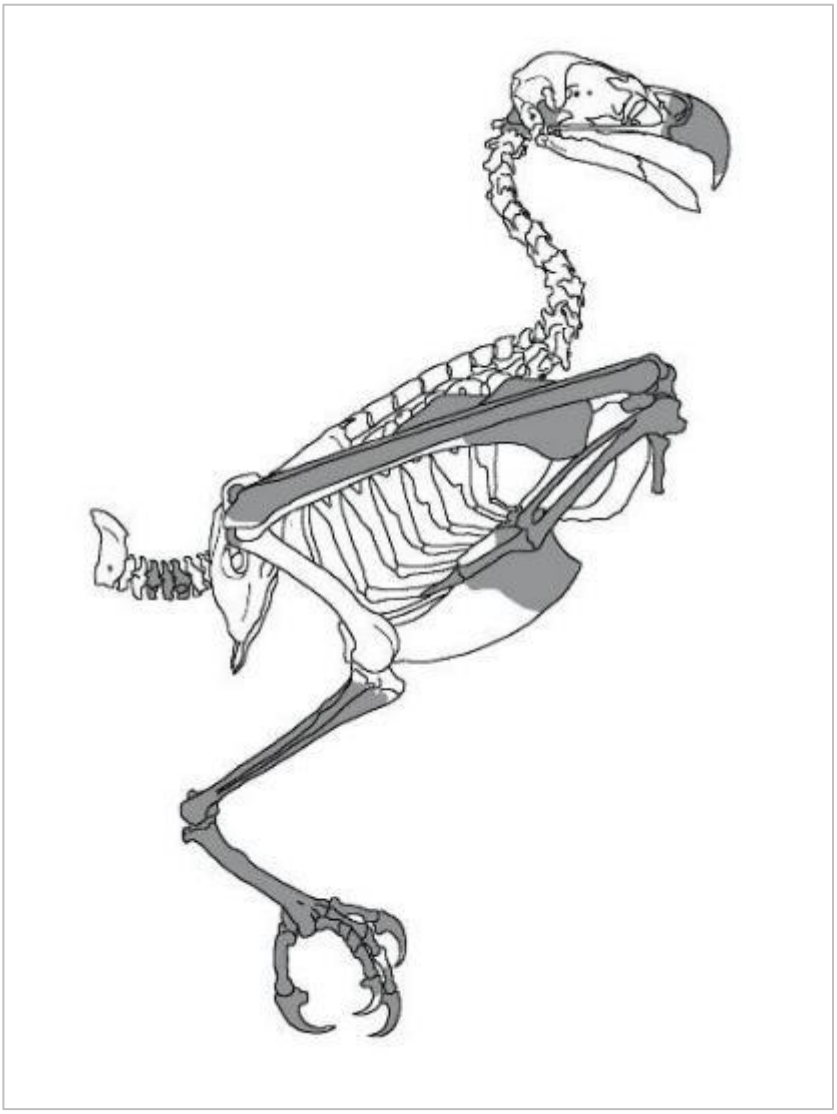
The parched deserts of the South Australian outback were once a rainforest filled with a rich variety of birds and animals. Now, thanks to a new fossil discovery, we know the apex predator of this lush ecosystem was a newly discovered eagle that lived 25 million years ago.

**Jacob Blokland/Flinders University, Author provided**

We discovered the fossil remains of this species, named *Archaehierax sylvestris*, in prehistoric sediments at Lake Pinpa, 400 kilometres north of Adelaide.

The fossil, unearthed in March 2016, is described in a newly published paper in the journal Historical Biology.

It is one of the most complete raptor fossils from this time period found anywhere in the world. It comprises 63 bones, which is truly exceptional; most fossil birds are named on the basis of just a single bone.



**Silhouette of an osprey skeleton with shading to show the bones preserved in the new fossil raptor, *Archaehierax sylvestris*. Ellen Mather, Author provided**

We have named it Archaehierax sylvestris, meaning “ancient hawk belonging to the forest”. It was slightly smaller than a wedge-tailed eagle, with talons spanning 15 centimetres that allowed it to grab prey the size of a koala or possum. And it had short, robust wings adapted to fly within the cluttered confines of a forest, rather than to soar through the skies.

With its relatively short wings and long legs, this eagle was likely an ambush hunter, waiting for unwary prey to approach, rather than a soaring forager. In the forest, it probably preyed on medium-sized

marsupials. But from a high perch, it would also have made forays over the lake where it could catch ducks and flamingos.

**Fossil treasure trove**

Since the 1970s, the barren, salt-crusted sediments in South Australia's arid north have yielded a range of bone fragments, teeth, and other fossils of the animals that lived there — many of which would have been prey for *Archaehierax*.


**The authors working on the excavation site at Lake Pinpa. Left to right: Aaron Camens, Amy Tschirn, Jacob Blokland, Kailah Thorn. By Trevor H. Worthy, Author provided**

These fossils include a host of mammals, ranging from wombat ancestors the size of a small cow, through a range of tree-dwelling herbivores such as possums and koalas, to small terrestrial carnivores no bigger than a mouse.

These animals lived around a large lake where crocodiles and turtles abounded, and freshwater dolphins played.

Waterbirds were abundant, including cormorants, several types of flamingo, four species of duck, and *Presbyornis*, a bizarre long-legged fowl that went extinct elsewhere in the world 20 million years earlier. Many smaller forest birds such as songbirds, parrots and rails are also known, but most are not yet described.

**Global eagle family**

*Archaehierax* was clearly a member of the raptor family, which includes most hawks and eagles. But its bones differed in many ways from all other raptors, including similar-aged ones from elsewhere in the world.

*Archaehierax sylvestris* was not the only raptor we found at Lake Pinpa. Isolated bones show a smaller eagle also lived in these forests, but the fossils are too fragmentary to give this species a name.

There is another fossil raptor known from deposits at Riversleigh World Heritage Area in northwest Queensland. *Pengana robertbolesi* is a few million years younger than *Archaehierax*, and not closely related to the Pinpa bird. It was adapted to capture prey in holes in trees.

Our analysis suggests *Archaehierax* was probably not closely related to any living raptor. Rather, it represented an ancient lineage that split off near the base of the raptor family tree. This is consistent with previous genetic analysis suggesting most living groups of hawks and eagles evolved only in the past 20 million years — roughly 5 million years after *Archaehierax* lived and died.

Previously, raptor fossils as ancient as 25 million years old were only known from Europe and North America. *Archaehierax sylvestris* and its smaller contemporary show that Australia was an important geographic location in the early global evolution of raptors.

Australia is already widely understood to be a cradle of evolution of songbirds, and our island continent doubtless played a similar role in the evolution of other types of birds too.

These raptors and the earliest songbirds lived in temperate rainforests. Back then, the area around what is now Lake Pinpa was located more than 1,100km south of where Adelaide is today, at a latitude equivalent to present-day Fiordland at the southwestern tip of New Zealand.

In the 25 million years since, continental drift has carried Australia and the fossils north at 6 centimetres per year (the speed at which your fingernails grow), travelling more than 1,500km.

The rainforest where these birds lived is now the arid outback. And there are almost certainly many fossils awaiting discovery there that will tell us more about how Australia's unique birds evolved.

**Left tarsometatarsus (lower leg bone) of the fossil raptor *Archaehierax sylvestris*, beside *Aquila audax* (Wedge-tailed Eagle). The fossil was distorted during burial so the top half is rotated 90 degrees to the lower half. Silhouettes show relative sizes of these birds. Scale bar represents 10 millimetres. Ellen Mather, Author provided**

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## Geologic Travel – The Azores by Jenny Lambert

The Azores consist of nine volcanic islands and an islet cluster in the mid-Atlantic that span more than 350 miles in a west-northwest to east-southeast orientation. The two westernmost islands (Corvo and

Flores) are on in the North Atlantic Plate, while the remaining islands are on the boundary of the Eurasian Plate and African Plate. This area is known as the Azores Triple Junction and is highly tectonically active because it lies at the intersection of the Mid-Atlantic Ridge (running north-south) and the Terceira Rift (running east-southeast). Each island has distinct geomorphology, including major craters, shield volcanoes, fissure eruptions, and fields of spatter cones.

Southeastern New England, particularly the New Bedford area and Rhode Island, has the highest population of people of Azorean (Portuguese) descent in the U.S. because of historically strong maritime ties (particularly whaling) going back centuries. A second wave of immigration came to the area after a series of eruptions from 1957-1958 at the island of Faial forced thousands of residents to leave. Thanks to these close connections, the Azores are well serviced by daily flights from Logan Airport (current conditions aside); the Azores can also be used as an easy stopover for flights to Portugal, much like Iceland for flights to northern Europe.

**Lighthouse partially buried in ash from the Capelinhos eruption (1957-1958) in Faial. An excellent museum is located here.**

Popular activities include canoeing/kayaking, hiking (including summiting Pico, for which a guide is recommended), canyoning/rappelling, surfing, and scuba diving. The Azores are one of the world's largest whale sanctuaries, and the whale watching companies use the old whaling observation posts to

locate the best spots to visit. If you can wrangle a trans-Atlantic yacht trip, you'll likely make a stop at the marina in Horta, on Faial (or you can catch an inter-island flight or ferry). We planned our visit for the annual car rally on San Miguel, which was definitely a bit of an adventure.

**Lagoa das Furnas hot springs, San Miguel**

**Vila Franca do Campo islet: a submerged crater just off the coast of southern San Miguel**

**Lagoa das Sete Cidades: two ecologically distinct lakes located within a large crater that are connected by a narrow strait, in San Miguel. From https://en.wikipedia.org/wiki/Lagoa_das_Sete_Cidades - it was too foggy to see from a distance during our visit**

**Cliffs on Faial with the nearby island of Pico in the distance. The eponymous volcano, which can just barely be seen over the top of the clouds, is the tallest mountain in Portugal.**

Suggested reading:

Volcanoes of the Azores: Revealing the Geological Secrets of the Central Northern Atlantic Islands. Ulrich Kueppers and Christop Beier, Eds. Springer, 2018

## Ready for 2022? Renew your GSNH Membership!

Membership comes with a discount on dinner meetings and field trips (which will happen at some point!), information on upcoming events of interest, voting privileges at Society business meetings, and automatic subscription to this newsletter. Membership dues also help to support important geological outreach for the greater community.

See last page of this newsletter for a membership renewal application.

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## Did the Earth tip on its side 84 million years ago?

Provided by Tokyo Institute of Technology, October 18, 2021. From Phys.org.
https://phys.org/news/2021-10-earth-side-million-years.html

**Scaglia Rossa Limestone exposed near Furlo, Italy, in the Northern Apennine Mountains. Limestone at this locality accumulated on the bottom of a shallow sea, in an arm of the ancient Mediterranean ocean nearly 85 million years ago, during Late Cretaceous time. Credit: Ross Mitchell.**

Hold on to your hats, because scientists have found more evidence that Earth tips over from time to time. We know that the continents are moving slowly due to plate tectonics, but continental drift only

pushes the tectonic plates past each other. It has been debated for the past few decades whether the outer, solid shell of the Earth can wobble about, or even tip over relative to the spin axis. Such a shift of Earth is called "true polar wander," but the evidence for this process has been contentious. New research published in *Nature Communications*, led by the Earth-Life Science Institute (ELSI) at Tokyo Institute of Technology's Principle Investigator Joe Kirschvink (also a Professor at Caltech) and Prof. Ross Mitchell at the Institute of Geology and Geophysics in Beijing, provides some of the most convincing evidence to date that such planetary tipping has indeed occurred in Earth's past.

True polar wander bears some dissecting. The Earth is a stratified ball, with a solid metal inner core, a liquid metal outer core, and a solid mantle and overriding crust at the surface which we live on. All of this is spinning like a top, once per day. Because the Earth's outer core is liquid, the solid mantle and crust are able to slide around on top of it. Relatively dense structures, such as subducting oceanic plates and massive volcanoes like Hawaii, prefer to be near the Equator, in the same way that your arms like to be out to your side when you are spinning around in an office chair.

Despite this wandering of the crust, Earth' magnetic field is generated by electrical currents in the convecting liquid Ni-Fe metal of the outer core. On long time scales, the overlying wander of the mantle and crust does not affect the core, because those overlying rock layers are transparent to Earth's magnetic field. In contrast, the convection patterns in this outer core are actually forced to dance around Earth's rotation axis, which means that the overall pattern of Earth's magnetic field is predictable, spreading out in the same fashion as iron filings lining up over a small bar magnet. Hence, these data provide excellent information about the direction of the North and South geographic poles, and the tilt gives the distance from the poles (a vertical field means you are at the pole, horizontal tells us it was on the Equator). Many rocks actually record the direction of the local magnetic field as they form, in much the same way that a magnetic tape records your music. For example, tiny crystals of the mineral magnetite produced by some bacteria actually line up like tiny compass needles, and get trapped in the sediments when the rock solidifies. This "fossil" magnetism can be used to track where the spin axis is wandering relative to the crust.

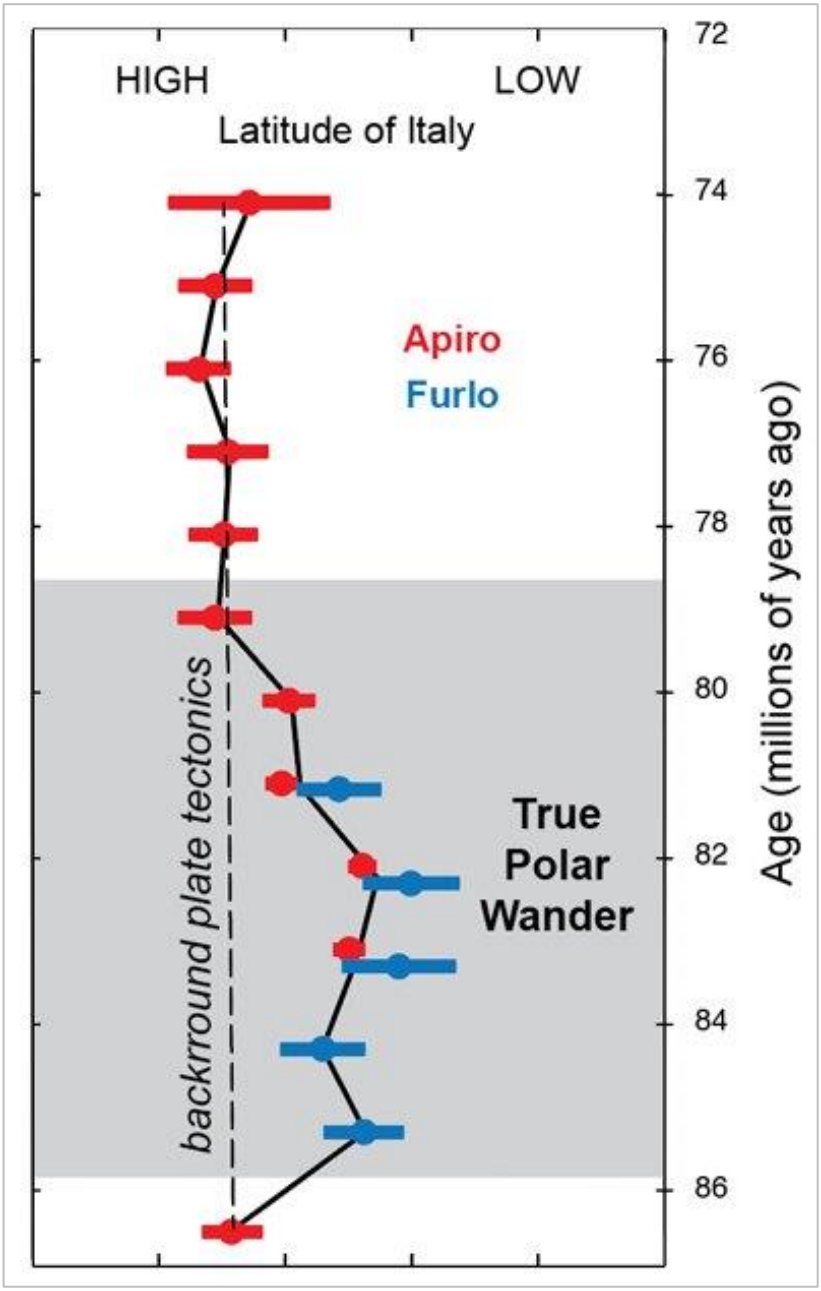
"Imagine looking at Earth from space," explains Kirschvink "True polar wander would look like the Earth tipping on its side, and what's actually happening is that the whole rocky shell of the planet—the solid mantle and crust—is rotating around the liquid outer core." Although scientists can measure true

polar wander occurring today very precisely with satellites, geologists still debate whether large rotations of the mantle and crust have occurred in Earth's past.

One particularly heated debate has been over events during the Late Cretaceous, about 84 million years ago. Over the last three decades, geophysicists have been going back and forth through public arguments in the journal Science, and at numerous meetings, about whether a large true polar wander event occurred in the Cretaceous.

**High-resolution sampling on the road cut west of the Apiro Dam lake, in the Central Apennine Mountains of Italy. This particular locality crosses the boundary of a major geomagnetic reversal, known as the Chron 33R / 33N transition, dated close to 80 million years ago. An amazingly high fraction of oriented samples from these localities yields superb records of the ancient magnetic field at the time they formed. Credit: Ross Mitchell.**

Mitchell and Kirschvink came up with a plan for settling the debate once and for all. Leveraging Mitchell's experience as a student studying the geology of the Apennine Mountains of central Italy, he knew just the right rocks to sample. The international team of researchers then placed their bet that paleomagnetic data from limestones created in the Cretaceous (between ~145.5 and 65.5 million years ago) located in Italy would provide a definitive test. The magnetism of the younger rocks in the same area was studied nearly 50 years ago, and indirectly led to the discovery of the asteroid impact that killed the dinosaurs. Sarah Slotznick, co-author and geobiologist at Dartmouth College explains, "these Italian sedimentary rocks turn out to be special and very reliable because the magnetic minerals are actually fossils of bacteria that formed chains of the mineral magnetite."




**Latitude shift recorded in the Scalgia Rossa Limestone of the Italian Apennines. These data show that Italy took a brief excursion towards the Equator between 86 and 80 million years ago, coincident with a rotation observed from magnetic data collected from rocks from the seafloor of the Pacific Ocean. Credit: Ross Mitchell and Christopher Thissen.**

To test their hypothesis about true polar wander, paleomagnetic data with lots of redundancy are required to track the wander of the ancient location of Earth's spin axis. Prior studies, especially some claiming that true polar wander does not occur, have failed to explore enough data points according to the team. Says Richard Gordon, a geophysicist at Rice University in Houston who wasn't involved in the study, "that is one reason why it is so refreshing to see this study with its abundant and beautiful paleomagnetic data."

Kirschvink and colleagues found, as the true polar wander hypothesis predicted, the Italian data indicate an ~12˚ tilt of the planet 84 million years ago. The team also found that Earth appears to have

corrected itself—after tipping on its side, Earth reversed course and rotated right back, for a total excursion of nearly 25˚ of arc in about five million years. Certainly, this was a cosmic "yo-yo."

**More Information**

Citation: Ross N. Mitchell et al, A Late Cretaceous true polar wander oscillation, Nature Communications (2021). DOI: 10.1038/s41467-021-23803-8

Journal Information: Nature Communications, Science

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## Geology of Badlands National Park

From Earth Science Picture of the Day, December 1, 2021.
Photographers: Charlene Lanik Sauls and Brian Sauls, Summary Author: Brian Sauls
https://epod.usra.edu/blog/2021/12/geology-of-badlands-national-park.html

The geology comprising the Badlands National Park in southwestern South Dakota is a colorful layer-cake of various sedimentary rocks deposited between 28 to 75 million years ago by shallow seas, rivers, and wind. The distinct rock layers consist of multi-colored sandstone, siltstone, mudstone, claystone, limestone, shale, and volcanic ash. Remarkably, the volcanic ash originated from volcanoes located over 500 miles (800 km) away in present day Nevada and Utah, which was blown eastward before settling in the park area. Over time, this deposited ash hardened into beige-colored volcanic tuff through the process of lithification.

In addition to geologic deposition, the Badlands Park region was further shaped by tectonic forces approximately 5 million years ago. The tectonics primarily shifted the underlaying rock strata through uplifting and folding forces. Since this period of the geologic history, the Badlands has been continually shaped by erosion as it has gradually formed the hills, valleys, stream channels, and other interesting features of this park. Because the rock layers are relatively soft, erosion occurs at a high rate of about one inch per year. At this rapid rate of erosion, estimates suggest that the hills of the Badlands will erode completely within the next half a million years. Photos taken in August 2021.

Badlands National Park, South Dakota Coordinates: 43.8554, -102.3397

Related Links

- Badlands National Park: Tunnel to the Past

Student Links

- USGS Geological Report of the Badlands National Park
- Geologic Map of Badlands National Park

Earth Observatory

- Badlands National Park

## GSNH Education Grant Update

By Lee Wilder

Attention NH Earth-Space Science Educators and NH Geology Students Need classroom teaching materials? Want to attend a workshop, conference, geology field trip or need financial help with your Earth Science project or thesis? Or enrich your subject content skills? The Geological Society of NH offers cash reimbursement for such purchases or expenses. No strings attached! See details below :

- http://www.gsnh.org/classroom-grant.html
- http://www.gsnh.org/lincoln-r-page-fund.html

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## What I did at NEIGC 2021

By Wayne Ives, Past President

This year's New England Intercollegiate Geological Conference was centered in Grafton Notch, Maine, although some trips went as far as Portland to visit the migmatites on the coast. After work Thursday night I went up to the Grafton Notch Campground on Route 26 in Newry, Maine. My campsite was within yards of the Bear River that runs down from Grafton Notch to the Androscoggin River. I had arrived just in time to attend Karen Johannesson's virtual presentation on Arsenic in Groundwater at the GSNH dinner meeting. I sat on a folding chair on the campground's porch, which was the only place where WiFi was available. I got back to my site in the dark, set up my tent and strung a tarp over the picnic table. I blew up my new air mattress and sat by the campfire enjoying the moon over the mountain top before turning in.

The next morning's field trip started at 9 am behind the Maine Mineral and Gem Museum in Bethel. We met up with new and old friends and the trip leaders behind the Maine Mineral and Gem Museum, where trip leaders, Al Falster and Dr. Skip Simmons, are researchers. I caught up with Society member Mark van Balen and we reminisced about the 2019 NEIGC trip. After condensing attendees into fewer and more rugged vehicles; Al Faltster's tiny, lime green, Smart car, led the pickup trucks and SUVs switchbacking over the rugged road and up the side of Uncle Tom Mountain. We dismounted at the Emmons pegmatite mine where Skip Simmons and Al Falster described their theory of the emplacement of the pegmatite. They believe, and were quite convincing, that this pegmatite was derived from anatexis instead of as a late stage fractionation of an igneous magma. Though told they were wrong by other experts, the emplacement timing and trace elements they described bore them out that melting of the country rock may be the source of the pegmatite. A bald eagle glided silently over as we scoured the tailings for exotic minerals and examined the blast face where Al drills and

blasts every Sunday throughout the year. Laden with our finds, we headed back down the mountainside for the evening.

**NEIGC attendees examine the Emmons pegmatite mine in Greenwood, Maine on Friday, October 15, 2021. Al Falster, research technologist at the Maine Mineral and Gem Museum (green shirt and shorts), explains his weekly blasting operations and recovery of minerals at the mine.**

I built a campfire and cooked dinner of stew and green beans at my picnic table. Overnight the rains came down on, and as it turned out, into my tent. I woke to find the bottom of my tent and most of my clothes (and a couple library books) were wet. Luckily the new air mattress kept me and my sleeping bag above the water. I sopped up the wet clothes and what I could of the puddle on the tent floor, strung a tarp over the tent and still managed to meet the next field trip at 8 am since its start just a mile or so down Route 26 from the campground. We stood in the drizzle in the Grafton Loop parking area for the start of the Puzzle Mountain field trip. Thor Smith, former GSNH board member, was attending and we got to catch up during the day. Chris Koteas, from Norwich University in Vermont, gave a regional overview and briefed us on what we were going to see. The big group, including geologists

ranging from 3-month freshmen to 75-year old professors, climbed the trail, first over glacial tills, and then finally got higher to where thinner sediments exposed several bedrock outcrops along the trail. At one, garnet-bearing intrusive rocks were exposed, and at the next, dozens of sequences of quartz-feldspar layers and garnet-bearing pelitic layers repeated in a large rock outlook. We had to imagine the view at the outlook because we were looking out through the clouds that were drizzling through the day over the mountain and the Bear River valley. I'll have to climb Puzzle Mountain again to see the view, but homemade cookies made up somewhat for the lack of scenery.

**Chris Koteas, NEIGC trip leader and Chair of the Department of Environmental Sciences at Norwich University, (kneeling) describes the regional geology as part of the trip up Puzzle Mountain in Newry, Maine on Saturday, October 16, 2021.**

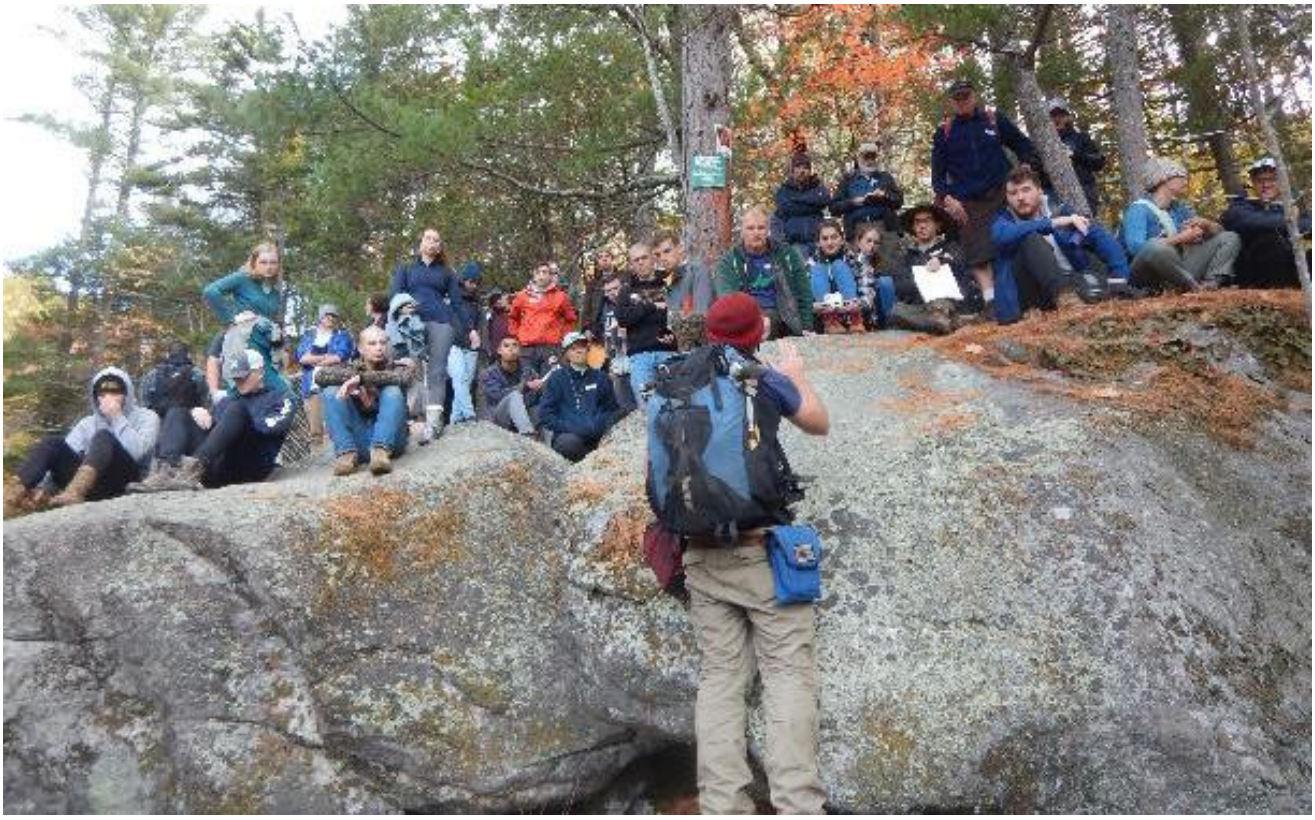
**Chris Koteas stands next to the sharp contact between the metasedimentary Rangeley formation and the intrusive granodiorite near the summit of Puzzle Mountain in Newry, Maine on Saturday, October 16, 2021.**

After returning down the trail to the parking lot, I drove into nearby Bethel, Maine and shoveled quarters into the laundromat dryers until my clothes, regardless of whether they were clean or already worn, were at least dry. On the way back to the campsite, I stopped at a roadside stand and bought a triple-berry fruit pie to go with dinner. Back at camp that night, a get-together on the campground's central green allowed students and professors and working geologists to hang out together. This was a nice substitute for the usual banquet get-together that had been cancelled because of ... well you

know. Geologists bearing potluck food and beverages drifted in as evening came on. A nice crowd came together despite threatening skies and occasional sprinkles. Students heard old stories from the older geologists, and described their own educational and work aspirations. The party broke up early as rain was certain for later in the evening and it had been a long day. I did my dishes at the camp's stone sinks, which are attached to the very nice restrooms, and went back to check my tarp set up. I wondered if I still had time for a fire before the downpour. Although the first flames got sprinkled out by an importunate early cloudburst, I carved up a large bundle of kindling and got a nice fire going that lasted through the next few sprinkling false starts. But I was driven to go to bed promptly at ten pm when a serious downpour started. I watched the light fade through the walls of my tent as the fire drowned.

I woke in the dark no damper than I had gone to bed thanks to my jerry-rigged tarp. The fog lifted with the sun and the morning broke clear, breezy and cool with yellow leaves dropping persistently. I rustled up a breakfast of coffee, eggs and corned beef hash and enjoyed the morning. Today's trip was only a minute from the campground going the other way up Route 26 to Step Falls Reserve. The stream at Step Falls washes over steep bedrock exposures. At the end of the trail after a short hike, Chris Koteas pointed out where the Rangeley formation was intruded by granodiorite and then both intruded by pegmatites. Today the clear fall sky let us view the rocky stream and Bear Valley's fall colors spreading clear to the next mountain top. From Step Falls, a long looping drive took us to the opposite side of the mountain to get a better sense of the relationship of these rocks. A trail, that was once part of the Appalachian Mountain Club trail, but later abandoned due to washouts, took us up the Cataracts. This stream, draining the opposite side of the mountain, also exposed and carved through the bedrock. Shear zones and possible thin mylonites were evident in the metasediments. A deep bedrock chasm and other smaller waterfalls by the trail made a nice backdrop to the hike and the geology.

I still had to pack up. The owner of the Grafton Notch Campground had kindly let us leave late, so I went back and finished loading my gear. It had dried a little more through the day. I said goodbyes and left thinking that I'd like to come back soon and explore more of the Bear Valley and Grafton Notch.



**Above and below: Chris Koteas describes the metasedimentary, granodiorite, pegmatite complex making up the rocks in the Step Falls Preserve, Bear River Road, Newry, Maine. Sunday, October 17, 2021.**

**Chris Koteas describes the granodiorite intruding the metasedimentary Rangeley complex at the Cataracts, on the opposite side of the mountain from the Step Falls Preserve, Newry, Maine. Sunday, October 17, 2021. The Cataracts Trail is in North Oxford, Maine on EB Hill Road aka Andover Road.**

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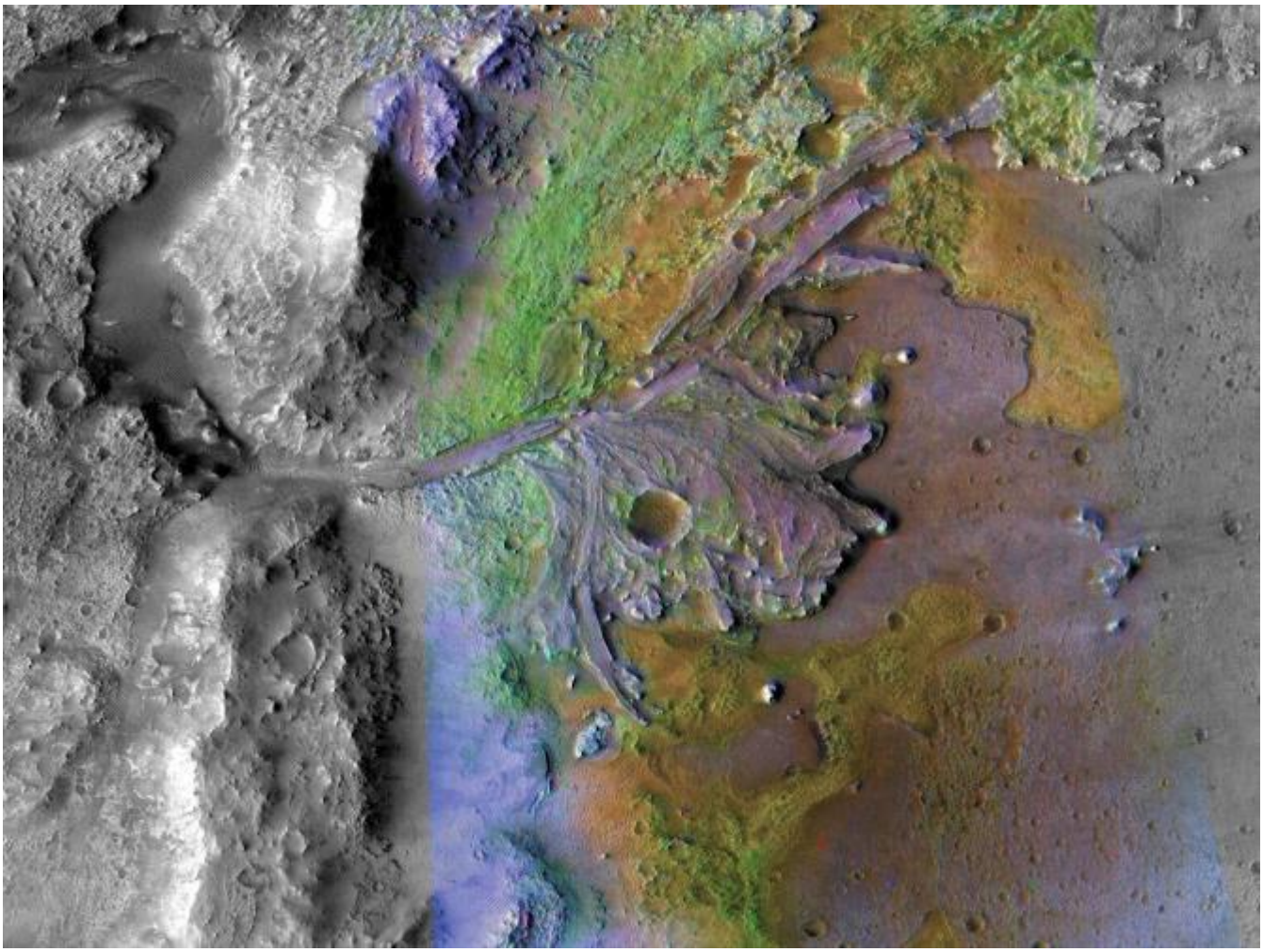
## Mars died billions of years ago, and its guts are still spilling into space

From Charlie Wood, Popular Science. November 12, 2020.
https://www.popsci.com/story/science/how-did-mars-die/

The Red Planet is a dead planet, but it may not have always been that way. Rovers and satellites have found clear evidence that the dusty Martian plains once flowed with rivers, which pooled into giant lakes, and perhaps fed into a global ocean. Warm and wet, ancient Mars may have offered a comfy climate for any emerging microbes, much like Earth did.

How times have changed. Billions of years later, Earth remains a blue marble while Mars has become a dry husk of its former self. While most of the desiccation resulted from the calamitous loss of Mars's atmosphere, the planet has kept some of its water. But even that meager supply is leaking away.



**Jezero Crater, the destination of the Perseverance rover, is one of many sites on Mars where ancient water flowed, suggesting that the planet once had a thicker atmosphere. NASA/JPL-Caltech/MSSS/JHU-APL.**

So how did Mars die? After repeatedly skimming the upper reaches of the Martian atmosphere with an orbiting probe, researchers have another piece of the puzzle—they discovered that H2O molecules are somehow slipping past a protective atmospheric barrier much more easily than predicted.

"This was unexpected," says Shane Stone, a planetary chemist at the University of Arizona and an author of the recent research, which was published today in Science. "When water is destroyed, the destruction is close to the edge of the atmosphere and it can escape quite readily."

In the early days of the solar system, baby Mars probably didn't look so different from baby Earth. Both planets had molten cores of electrically charged metal. The metals churned with liquid currents, erecting magnetic barriers around the planets. These magnetic fields repelled both the solar wind and electrical assaults from frequent flares during the sun's tumultuous youth, protecting planets' the nascent atmospheres. Enveloped by thick layers of air, water streamed on both surfaces.

But Mars was too small to have a real shot at staying habitable in the long run. It cooled down faster than its larger sibling did. The core congealed. The protective magnetic barrier fell. And the sun blasted away much of the atmosphere. Most of the liquid water on the surface soon followed it into space. Reconstructing this three-billion-year history has been the main task of the Mars Atmosphere and Volatile EvolutioN (MAVEN) satellite, which has orbited the Red Planet since 2014.

Now new measurements from MAVEN have added new details to the most recent chapter in the Martian water exodus.

Since the late 1960s, planetary scientists had assumed that Mars's surviving stores of H2O were relatively safe. Blocks of ice on or near the surface would steadily transform into molecules of water vapor, which would rise into the thin atmosphere until it got too cold and they condensed into clouds. The same barrier of chilly air—the "hygropause"—protects water on Earth by trapping it into clouds and preventing the hydrogen from floating away.

Then came MAVEN, which dips into the edge of the atmosphere with every orbit and directly samples the ions that come from Martian water. Reconstructing the original molecules, Stone and his colleagues were surprised to find that plenty of H2O was wafting about at more than 90 miles above the surface—way above the hygropause. Water that high up in the atmosphere is destined to be smashed into oxygen. The oxygen continues to break down, while the hydrogen is light enough to flit away from the planet forever.

By analyzing how the upper atmosphere's water content changes over time, the team also uncovered two hints as to why Mars has such a lousy hygropause.

First, MAVEN detected an atmosphere that got drier in the winter and damper in the summer. Second, the spacecraft has been orbiting Mars for long enough to bear witness to a couple of regional dust storms, during which the water content jumped. The orbiter also happened to be operating during a dust storm in June of 2018 (a once-in-a-decade event so ferocious it killed the Opportunity rover), which caused moisture in the upper atmosphere to leap to roughly twenty times its normal levels.

These trends, Stone says, strongly suggest that Mars's hygropause regularly breaks down because the atmosphere gets too warm, such as when the planet draws closer to the sun during the summer months, or when the atmosphere swirls with dust. Independent temperature readings from another spacecraft confirmed that the atmosphere's wet periods line up with its relative heat waves.

While the Martian hygropause was never supposed to form a perfect seal, MAVEN's measurements suggest that it leaks far more than predicted. Over the last billion years, seasonable warming, annual regional dust storms, and decadal superstorms have caused Mars to lose enough water that could cover the planet in a global ocean two feet deep, the researchers estimated. That's just a few percent of the water Mars has lost over its entire history (which would be enough to flood the planet in an ocean many dozens to hundreds of feet deep), Stone says, but it's the main way the planet continues to dry out today.

While the dehydration of Mars would have devastated any life clinging to its surface, terrestrial organisms can breathe easy knowing that we won't suffer quite the same fate. Earth does constantly lose H2O to "atmospheric escape," but at a rate that's far too slow to be of any concern, according to Stone. Rather, our planet has one to two billion years left of being blue, after which a brighter sun will evaporate our oceans, cranking up the thermostat to a few hundred degrees.

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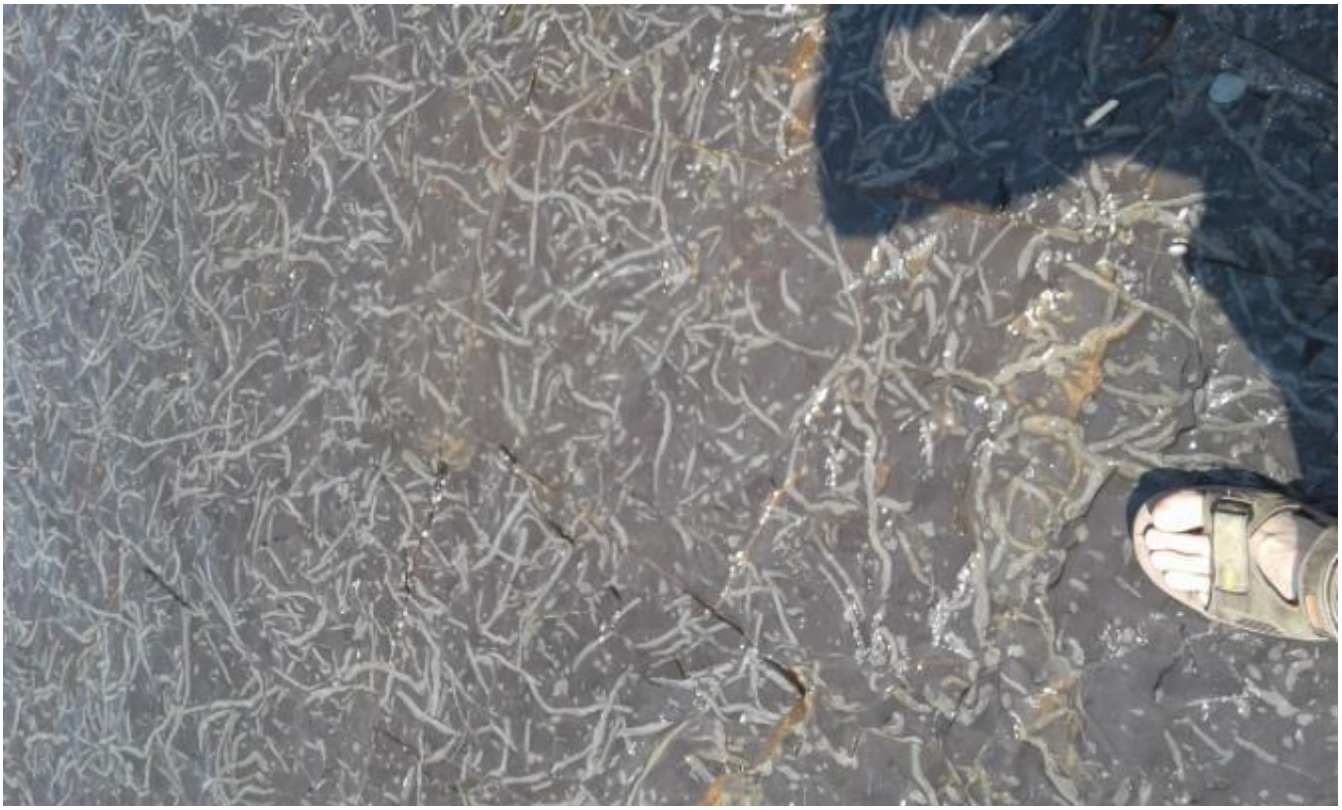
## Trace Fossils in Hanover Formation

From Earth Science Picture of the Day, October 7, 2021.
Photographer and Summary Author: James R. Ebert
https://epod.usra.edu/blog/2021/10/trace-fossils-in-hanover-formation.html

Unlike body fossils (shells, bones, chitinous material, plant tissue, etc.), which are the actual remains of once living organisms, trace fossils or ichnofossils are marks (burrows, tracks, trails, etc.) made by the activity or behavior of an organism. This photo [next page] shows an abundance of burrows of the ichnogenus Planolites in a bed of dark gray to black shale in the Hanover Formation, exposed in Sheridan Bay on Lake Erie, east of the city of Dunkirk, New York. The contrast between the sediment fill of the burrows and the surrounding shale is enhanced because the bed containing the burrows is wet owing to its position at lake level. Note that the trace-makers responsible for Planolites were probably worm-like creatures that tunneled through the mud, ingesting the sediment, digesting the organic matter that it contained, and excreting the undigested sediment as fill in the tunnels behind the organisms. Photo taken on June 28, 2021 [next page].



Ralson, PA Coordinates: 42.5186, -79.2686

Related Links:

- Arthrophycus
- Pennsylvania Anticline-Syncline

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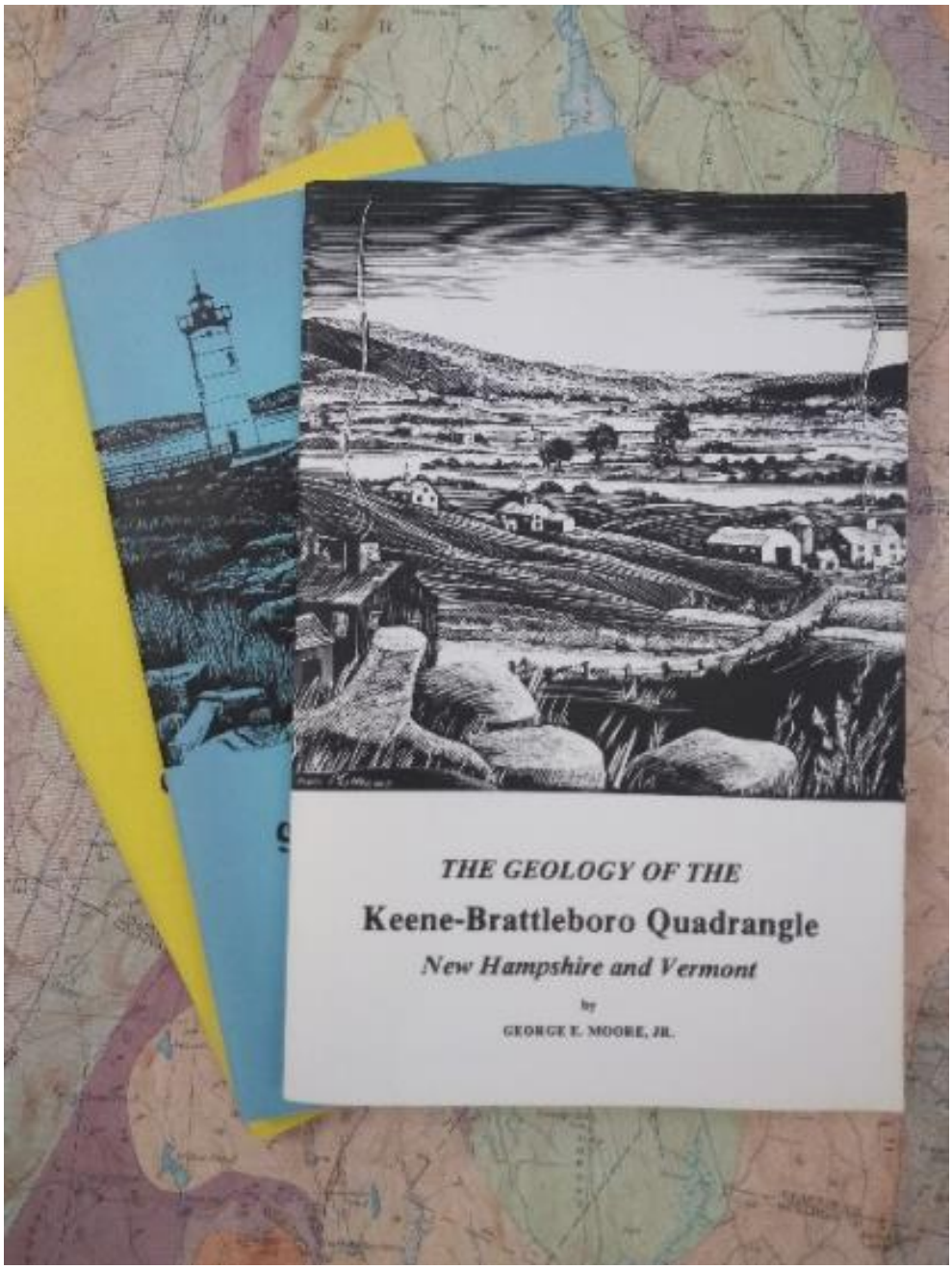
## New Hampshire Geological Survey Update

By Shane Csiki, State Geologist and Director, December 2021

It has been a busy time at the New Hampshire Geological Survey (NHGS) during the summer and fall of 2021. As you know, Rick Chormann, our former State Geologist, retired on April 22 after 37 years of State service, 10 of which were as State Geologist. With Greg Barker taking a position elsewhere in NHDES, Mike Howley joined NHGS as our new Geoscience Program Specialist in October. Rebecca LeCain began as our Outreach and Education Coordinator in April. With many new staff, and the change in roles, NHGS has turned to a new chapter in its book. The past months can be summarized by the theme of taking stock, and planting the seeds for the NHGS of the 21st century, while also working to maintain provision of the core earth science services we provide, and working to build upon the work of the previous chapter, led by Rick Chormann.




During the past few months, NHGS staff have been discussing and executing ways to streamline our business processes to help us become more efficient in providing the latest technical information regarding New Hampshire geology and water resources to our users, including all of you. To that end, Rebecca has been working on a project to make more of NHGS' publications available online. In an effort to make as much information accessible to the general public as possible, NHGS is adding older geologic maps and bulletins to the many open-file maps already in the publications library at the Department of Environmental Services' website;

https://www.des.nh.gov/resource-center/publications?keys=geology. Anyone will be able to view and download PDF versions of these publications. Plus, they will be searchable by quadrangle, bedrock or surficial geology, author, and town so they will be easier to find.

Mike, in his role, has assumed responsibility for the New Hampshire Groundwater Level Monitoring Network. He has hit the ground running and quickly dived in to learn and understand our business processes. If you take a look at our most recent groundwater level monitoring report (November 2021, Link Here), you'll note that Mike has made some refinements to the data display which will further enhance the ability of users to understand the current groundwater conditions at our wells across New Hampshire.

NHGS has been dedicated to its mission of collecting data and performing research on the earth sciences of New Hampshire. Moving forward, we will be working to find additional ways to better serve user needs, both within NHDES, as well as all users, including other state and federal agency partners, and consultants. We will be taking guidance from the results of the NHGS Stakeholder Survey that Rick conducted a few years ago, which we have been discussing internally.

With these recent developments at NHGS, combined with changes that have come with STATEMAP, and the current difficulties in filling open positions – not to mention coming out of COVID – 2021 has been a challenging year for NHGS. However, the staff of NHGS have been working hard to streamline operations and discover new ways to be efficient in order to be an active 21st century geological survey that contributes to New Hampshire. We welcome any suggestions as to how NHGS can better serve you. Feel free to reach out to any NHGS staff member anytime.

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## From Deep Within Earth's Mantle, This Never-Before-Seen Mineral Hitched a Ride to the Surface in a Diamond

From Rasha Aridi, Smithsonian Magazine, November 16, 2021.
https://www.smithsonianmag.com/smart-news/scientists-identify-a-never-before-seen-mineral-from-deep-within-the-earth-180979068/

At 1,800-miles-thick, Earth's mantle makes up roughly 84 percent of the planet's volume. However, the layer of mostly solid rock is characterized by intense heat and crushing pressure, which makes it difficult for geologists to study. Instead, they study the minerals and rocks that come to the surface, typically via volcanic eruptions. Now, a team of scientists have discovered a new mineral trapped within a diamond, according to a new study published last week in the journal *Science*.

The researchers named the mineral davemaoite, after the well-known geophysicist Ho-kwang (Dave) Mao. The mineral—calcium silicate perovskite—originated more than 400 miles underground and provides geologists with a glimpse of the chemical makeup of the lower mantle, reports Harry Baker for *Live Science*.

Before this discovery, scientists had managed to synthesize the mineral in a lab using a high-pressure environment, but its chemical structure immediately rearranged itself once the mineral was removed from 20 gigapascals of pressure. Scientists knew that this mineral likely existed in the mantle, making it presumably impossible to find a natural sample without drilling miles deep beneath the ocean floor, reports Stephanie Pappas for *Scientific American*.

**The researchers named the mineral davemaoite, after the well-known geophysicist Ho-kwang (Dave) Mao. Aaron Celestian, Natural History Museum of Los Angeles County**

"The chances, we thought, of finding it were so low that we never really actively looked for it," lead author Oliver Tschauner, a mineralogist at the University of Nevada, Las Vegas, tells *Scientific American*.

Typically, deep-Earth minerals reform as they are pushed from the mantle and towards the crust, but this mineral hitched a ride in a diamond, reports Carolyn Gramling for *Science News*. Diamonds form in the mantle and are blasted to the Earth's crust with volcanic eruptions. Under high temperatures and pressure, carbon atoms form super strong bonds with each other, which ultimately allows diamonds to withstand changes in pressure—such as from the mantle to the surface—without rearranging their structure, Smithsonian mineralogist Jeffrey Post said in a Q&A.

The davemaoite appeared as small black flakes embedded in the diamond, which was mined more than 30 years ago in Botswana. When Tschauner and his collaborators got their hands on the diamond a few years ago, they used X-rays and other techniques to reveal the chemical makeup of the specks, which they concluded was a new-to-science mineral that originated several hundred miles deep at the upper boundary of the lower mantle, reports Alexandra Witze for *Nature*.

Around 5 to 7 percent of the lower mantle could be made up of davemaoite. Although the new mineral is mostly made up of calcium silicate, there could be traces of radioactive elements such as thorium and uranium. When these elements decay, they release heat; estimates suggest they produce about a third of the heat in the lower mantle. By identifying the radioactive traces that make up davemaoite, scientists have a better understanding of where in the mantle those elements lurk, reports *Science News*.

"The work by Tschauner [and collaborators] inspires hope in the discovery of other difficult high-pressure phases in nature," Yingwei Fe, a geophysicist at the Carnegie Institution for Science writes in a commentary on the study. "Such direct sampling of the inaccessible lower mantle would fill our knowledge gap in chemical composition of the entire mantle of our planet."

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## Rock Glacier in Colorado Rockies

From Earth Science Picture of the Day, November 16, 2021.
Photographer: Stan Wagon, Summary Authors: Andrew Fountain and Stan Wagon:
https://epod.usra.edu/blog/2021/11/rock-glacier-in-colorado-rockies.html

Rock glaciers are accumulations of ice and rock with rock exposed on the surface and ice hidden within the interior. Unlike talus slopes, rock glaciers flow. There are more than 650 rock glaciers in the Colorado mountains and this photograph shows a rock glacier near Colorado's Mt. Elbert (14,430 feet

or 4,398 m), the highest peak in the Rocky Mountains. This feature is on the northeast side of the southeast ridge of Bull Hill (13,761 feet or 4,194), just south of Elbert. One can deduce the existence of ice under the rocks from the steepness of the rock face at the snout, the general inflated shape, and the evidence of down-valley flow. The example shown does not extend much down-valley so it may not be moving. Thus we would think of it as a "feature of interest", meaning that it has characteristics suggesting the presence of ice and might be a rock glacier. Photo taken on September 22, 2021.

Photo details: SONY A6500 camera; ISO 250; f/14; 1/250 second exposure; 53 mm.

Bull Hill Mountain (southeast ridge), Colorado Coordinates: 39.09472, -106.454

Related Links:

- Mt. Powell, Montana
- Johnson, G., Chang, H., & Fountain, A. (2021). Active rock glaciers of the contiguous United States: Geographic information system inventory and spatial distribution patterns. Earth System Science Data, 13(8), 3979-3994.

## **December Legislative Committee Report** by Tom Fargo

Below is a list of 2022 NH General Court (House and Senate) Bills that are potentially relevant to members of the Geological Society of New Hampshire. This table lists bills identified by keyword searches completed on December 14, 2021. Additional bills are likely to be submitted.

| Bill No. | Title | Bill Description |
|---|---|---|
| Key Word "**Environ**" | | |
| **HB-1452 -FN** | renaming the department of environmental services the department of environmental protection and assigning the department oversight of private drinking water wells. | This bill enables the Department of Environmental Services to enter private property to inspect and sample private wells and also changes the name of the "Department of Environmental Services" to the "Department of Environmental Protection"<br><br>Note: The FN designation indicates the bill contains a fiscal note describing the impact of the bill on the State budget. In this case the cost was described and an indeterminable increase in expenses to the Department. |
| Key Word "**Water**" | | |
| **HB-1167** | establishing a maximum contaminant level for perfluorinated chemicals in surface water. | This House bill proposes to set the following maximum contaminant levels in surface waters:<br>(a) Perfluorooctanoic acid (PFOA): 12 parts per trillion.<br>(b) Perfluoroctanesulfonic acid (PFOS): 15 parts per trillion.<br>(c) Perfluorohexanesulfonic acid (PFHxS): 18 parts per trillion.<br>(d) Perfluorononanoic acid (PFNA): 11 parts per trillion.<br>(e) Perfluorobutyrate (PFBA): 7 parts per trillion.<br>(f) Perfluorobutanesulfonic acid (PFBS): 1000 parts per trillion.<br>(g) The total contaminant levels of subparagraphs (a) through (f): 20 parts per trillion. |
| **HB-1185** | relative to treatment of water contaminated with perfluorinated chemicals. | Key provisions: 1) A wastewater treatment plant may require any industrial or commercial facilities or septic haulers contributing discharge to its plant to test such discharge to determine the level of PFAS in the discharge. 2) A wastewater treatment plant may refuse discharge from an industrial or commercial facility or septic hauler that has reported a level of PFAS in its discharge above the level the wastewater treatment plant determines to be acceptable. 3) A municipality or other governmental entity owning or controlling a waste treatment facility may fine discharge producers for providing discharge containing a level of PFAS above the level the wastewater treatment plant has determined to be acceptable. |

| Key Word "**Waste**" | | |
|---|---|---|
| **HB-1420-FN** | prohibiting the issuance of new landfill permits until the state's solid waste plan is updated. | Requires the Department of Environmental Services shall not issue a permit for the construction of a new facility unless the department makes a positive determination that the permit application is consistent with the state's solid waste plan that has been updated consistent with the requirements of RSA 149-M:29. |
| **HB-1121** | relative to new solid waste sites | Requires applications for permits to construct and operate a new privately-owned solid waste landfill shall submit evidence to the department of environmental services that the applicant is in compliance with all insurance and surety bonding requirements of the state and federal government. The applicant shall also provide evidence to the jurisdictions in which it will be located, and all adjacent jurisdictions, that the applicant qualifies for and will obtain a surety bond against any and all damages caused to individuals and businesses located within those jurisdictions as a result of operation of the solid waste landfill. |
| Key Word "**Professional**" as potentially related to Geologists | | |
| **HB-1019** | establishing a committee to study the replacement of certain professional licenses with mandatory minimum liability insurance requirements. | This bill would establish a committee to study the replacement of certain professional licenses with mandatory minimum liability insurance requirements. The members of the committee shall be as follows: (a) Three members of the house of representatives, appointed by the speaker of the house of representatives. (b) Three members of the senate, appointed by the president of the senate. |

Key word searches with no returns: **geology, mineral, rock, soil**

# GSNH T-Shirt Order Form

| | Number of Shirts | Price per Shirt | Total |
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| **GSNH Small T-Shirt** | | $18.00 | |
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| ~~**GSNH Extra Large T-Shirt**~~ | | ~~$18.00~~ | |
| | | Subtotal | |
| | | Shipping & Handling | |
| | | **Total** | |

| **Shipping & Handling costs** | |
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| One Shirt | $4.00 |
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**P.O. Box 401**
**Concord, NH 03302**

## JANUARY MEETING ANNOUNCEMENT

**TOPIC:** The First Radiocarbon Date for the Mount Holly Mammoth and its Implications for Human/Megafaunal Interactions in New England

**SPEAKER:** Nathaniel R. Kitchel, Dartmouth College

**DATE/TIME:** 7PM, January 20, 2022

The Mt. Holly mammoth, discovered in 1848 in Mt. Holly Vermont, was among the first well documented mammoth finds in New England. Until recently the absolute age of these remains had not been determined. A radiocarbon date of 10,860±30 returned in the spring of 2020 makes the Mt. Holly mammoth one of only nine well dated proboscidean (mammoth or mastodon) finds in New England and the youngest set of remains yet dated in the region. This relatively recent date has implications for the potential temporal overlap between the first peoples and the last proboscideans of the region and provides a better understanding the role of climate change and human predation played in the eventual extinction of these animals in New England and worldwide.

Please send Sharon Lewandowski an email to request a Zoom invite for the January meeting: sharon.lewandowski@des.nh.gov.

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## DATES TO REMEMBER

Please check online or the contact info below to confirm the status of these events. The list is current as of publication date but may change.

January 20, 2022 – **GSNH Meeting** – See section above.

March 10, 2022 – **GSNH board meeting**, location TBD

March 31, 2022 – **Maine Sustainability & Water Conference**, Augusta Civics Center https://umaine.edu/mitchellcenter/2022-maine-sustainability-water-conference/

March 20-22, 2022 – **Geological Society of America NE Section Meeting** – Lancaster, PA: https://www.geosociety.org/GSA/Events/Section_Meetings/GSA/Sections/ne/2022mtg/home.aspx?_zs=SFO7k1&_zl=1WE38

April 21, 2022 – **GSNH dinner meeting** – location TBD

April 30-May 1, 2022 – **New England Gem & Mineral Show 2022**. Coolidge Hall and The Fair Trade Building at the Topsfield Fairground. Details to follow in next edition.

June 2022 – **Friends of the Pleistocene Summer Field Trip**. Look for more details in future issues.

Looking for some continuing ed credits? Some webinar series are below:

- clu-in.org compiles webinars of interest to EPA and the environmental community here: https://clu-in.org/training/#upcoming
- The geoscience online learning initiative (GOLI) has several webinars and short courses that are free, but do include an administrative fee for continuing ed credits: https://www.americangeosciences.org/workforce/goli

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

***Membership Category:***

__ *Regulations Committee*
__ *Education Committee*
__ Events Committee

__Communications Committee
(Newsletter or Website, circle preference)
__ Other:

_____ 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: _____