PITTSBURGH GEOLOGICAL SOCIETY

March 17, 2021

Virtual Meeting Times

Board Meeting	6:00 PM
Social Gathering	7:00 PM
Presentation	7:30 PM

Pre-Registration is Required

To receive the Zoom link, PGS members and guests must RSVP at: pittsburghgeologicalsociety.org

PDH Certificates are Available

Attendees can receive an emailed PDH certificate at their request. Non-PGS members are asked to kindly donate $10 to either the Pittsburgh Geological Society Endowment Fund or the PGS Galey Fund for Students when they request a certificate on the PGS website.

Online Meeting Guidelines

All attendees are encouraged to join the meeting no later than 7:20 PM when announcements will be made. PGS requests all attendees to mute their own audio and video during the presentation to avoid disruptions and to lower bandwidth.

Cenozoic Magmatism: A Key to the Dramatic Landscapes of the Colorado Plateau

Canyonlands National Park in Utah. Photo credit Luke Parsons.

Dr. Kendra Murray

Assistant Professor
Department of Geosciences
Idaho State University

Please RSVP by March 16 to receive the Zoom link.

Abstract

Deciphering the geodynamic history of eroded landscapes like the Colorado Plateau (southwestern USA) is challenging because erosion destroys the rock record. Even with excellent exposures of distinctive Paleozoic and Mesozoic strata, which offered late 19th century geologists a guide to the total amount of rock removed from the Plateau by Cenozoic erosion, it was not until the development of low-temperature thermochronology a century later that it became possible to infer the spatial and temporal scales of erosion itself—using rock cooling as a proxy for rock exhumation via erosion. Apatite thermochronology is, in principle, uniquely suited to document the Cenozoic erosion of the Colorado Plateau and settle generations of debate regarding the region's history of uplift, erosion, and fluvial incision, including the formation of world-famous features like the Grand Canyon. However, the protracted near-surface history of the Colorado Plateau bedrock complicates the temperature sensitivity of apatite thermochronometers. This has confounded efforts to see clear evidence of late Cenozoic erosion, especially in the central Colorado Plateau, where this problem is compounded by the diverse detrital apatite grains in the region's sedimentary bedrock. We overcame this problem in the thermal aureole of the Oligocene (ca. 28-25 Ma) Henry Mountains intrusive complex in SE Utah, where these sandstones were heating during magmatism and therefore have apatite (U-Th-Sm)/He ages that clearly resolve a distinctive late Cenozoic history. Thermal history modeling results strongly suggest that the central Colorado Plateau was a stable Miocene landscape that was rapidly exhumed ~1.5–2 km during the past 5 m.y., likely in the past 3–2 m.y. This demonstrates that substantial late Cenozoic erosion of the north-central Plateau interior postdates the ca. 5.6 Ma integration of the Colorado River that lowered regional base level.

Speaker Biography

Kendra is a geologist who uses geochemistry, along with fieldwork and numerical modeling, to study the deep-time evolution of mountain belts and landscapes. During the last decade, she has evolved from an igneous petrologist interested in lithosphere-scale tectonics to a thermochronologist who investigates the many magmatic, geomorphic, and tectonic processes that change rock temperatures—from wildfire to the eruption of large igneous provinces. She has worked in Nova Scotia, Tierra del Fuego, the Antarctica Peninsula, Nepal, the central Andes of Chile and Argentina, and across the western United States. Much of her active work is focused on the geodynamic evolution of Colorado Plateau and Rocky Mountains from Proterozoic to Recent time. She also has an ongoing interest in active learning in geology classrooms. Kendra graduated from Carleton College and has a M.S. and Ph.D. in Geosciences from the University of Arizona. Prior to joining the faculty at Idaho State University in 2019, Kendra was Postdoctoral Research Fellow at the University of Michigan–Ann Arbor and a Visiting Assistant Professor at Hamilton College in Clinton, NY.

PRESIDENT'S STATEMENT

A Geologist's Perspective

I am constantly amazed at the scientific advances that improve our knowledge of the natural world. Recently, archaeologists uncovered a bronze and mineralized wood chariot from the ancient city of Pompeii that was blanketed with a thick layer of ash during the 79AD eruption of Mt. Vesuvius. This discovery, like so many from Pompeii, improves our understanding of the residents of this ancient civilization, their artistry and class structure. From a geological perspective, volcanic eruptions from stratovolcanoes like Vesuvius are catastrophic and potentially result in the tragic loss of life and destruction of habitats. But we have learned that environments do recover over time and we have realized that deposits from these eruptions have the potential to preserve and capture life of the past. We are not only able to learn about the ancient culture that once existed, but we have an opportunity to improve our understanding of geologic processes as well.

The landing of Perseverance on Mars is another remarkable scientific success that made the headlines within the past few weeks. In my mind, this has thrust science to a whole new level. This sophisticated mobile laboratory will study the Mars geology and climate while at the same time collect geologic samples that will hopefully catch a ride back to Earth on the Mars Fetch vehicles. This and future missions will hopefully collect the data to finally answer the question of whether life exists or has existed on Mars as well as prepare science for the first manned missions to the Red Planet. For most people, the most intriguing question is to answer whether life exists on Mars; for others it is the phenomenal imagery depicting what life on Mars looks like. Regardless of what thrills you most from this scientific endeavor, it is certain that we will learn more about the planet's geologic history and enhance our understanding of planetary systems.

Studying the ancient histories of magmas reminds us that geology is more than observing surficial processes and the search to understand ancient life. Teaching petrology this semester has reopened my fascination with the microscopic world of rocks. The details preserved in the chemical and crystal structure of rocks provides the data to understand the evolution of magma and processes occurring deep within Earth.

From a geologist's perspective, we can focus on the big picture processes that have shaped the planetary bodies, develop an understanding of volcanic processes resulting in the preservation of past cultures, or use microscopic clues to decipher the processes deep within the earth. I am constantly reminded of the wonders of the natural word from the myriad discoveries that improve our knowledge.

In closing, I would like to congratulate Karen Rose Cercone for becoming our newest Honorary Member. Karen Rose has been an active member of PGS since 1986 and has served as secretary, treasurer, vice president, president, and editor of the newsletter (twice). Since I have been president, Karen Rose has dedicated her time to revitalizing our webpage, modernizing the format of our monthly newsletter, helping to administer our society's LinkedIn page, and organizing a field trip to southern Indiana County. She also organized a workshop to familiarize PGS members with the fundamentals of Geographic Information Systems (GIS) back when the technology was being developed. I appreciate all the time she has committed to PGS and am pleased to award her an honorary membership.

Thanks to all the members who are continuing to engage at our monthly meetings and to our corporate sponsors. It is because of our sponsors and members that PGS has remained a vibrant geological society for over 75 years. I look forward to seeing you all at our next meeting.

Tamra

UPCOMING PGS MONTHLY MEETINGS

Meeting Date	*Scheduled Speaker*	*Presentation Topic*
April 21, 2021	Student Research Night Joint Meeting with ASCE and AEG	Student Posters & Presentations
May 19, 2021	Thomas Bardol, Seneca Resources	Oil and Gas Industry Talk

OTHER GEOLOGICAL EVENTS

Pennsylvania Council of Professional Geologists

March 9, 2021 **1:00 PM – 2:00 PM**

"Water Law Meets Geology in a Time of Change: Pennsylvania and Water Governance" by Lara B. Fowler, Penn State Law Assistant Director, Penn State Institutes of Energy and the Environment

For more information and to register: https://pcpg.org/event-4160283

March 30, 2021 **1:00 PM – 2:00 PM**

"The West Virginia Landslide Risk Assessment: What LiDAR-Based Mapping in the Mountain State Shows about Pennsylvania Landslides" by Dr. Steven J. Kite (ret.), West Virginia University.

For information and to register: https://pcpg.org/event-4151765

Harrisburg Area Geological Society

March 11, 2021 **6:30 PM – 7:30 PM**

"The Geology Along the Northwest Lancaster County River Trail" by Jeri Jones, Jones Geological Services.

To RSVP: secretaryhags@gmail.com

ASCE Geo-Institute Pittsburgh Chapter

March 18, 2021 **12:00 PM – 1:00 PM**

"Emergency Repairs to Mosul Dam - High Risk Dam on Karst" by Deep Foundation Institute Traveling Lecturer David B. Paul PE, Paul GeoTek Engineering and former US Army Corps of Engineers.

For more information: http://www.asce-pgh.org/event-4087874?CalendarViewType=1&SelectedDate=3/27/2021

PGS STUDENT PAGE

Annoucements:

- A student meeting has tentatively been scheduled for March 10, 2021. More information and a Zoom link will be sent out by email.

- March 26 is the deadline for participating in the student research night. This is a great way to network with working geologists from across the region, some of whom may be hiring for entry-level positions in the future. See more details on the next page and talk to your faculty advisor about presenting your research. It's easier than ever in our virtual format!

- March 31 is the deadline for participating in the national AGU Bridge Program. This program increases opportunities for students from underrepresented populations to obtain graduate degrees and creates a network of peers, mentors and advisers to support and serve them before, during and after grad school. The program is open to those who have not applied to graduate school, or applied and were not accepted. For more information: https://www.agu.org/bridge-program

- It's always worth checking out the many different grants and scholarships offered by the Geological Society of America. Both graduate and undergraduate student research grants are available, including some offered by the regional GSA chapters. For more information, check out this site: https://www.geosociety.org/GSA/Education_Careers/Grants_Scholarships/GSA/grants/home.aspx?hkey=e4133995-e8fd-43a7-b169-7323b0d72ee9

- For any other questions or suggestions from students, please contact PGS student liaison Michael Behe at mpb1017@sru.edu.

The Pittsburgh Geological Society welcomes the following:

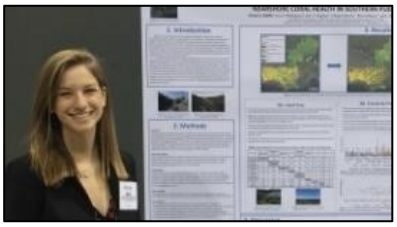
New Professional Member
Thomas E. Buchan, PG
PA Dept. of Environmental Protection
Johnstown, PA

New Student Members
James J. Barno
California University of Pennsylvania

Cole R. Miller
University of Pittsburgh

PGS – AEG – ASCE STUDENT NIGHT

April 21, 2021



University students, please consider presenting the results of your college research projects at the **19th Annual PGS – AEG – ASCE Student Night Meeting**. If you have been conducting undergraduate or graduate research in any geological or geotechnical field, here is an opportunity to show off your work to members of three professional scientific societies. Students who present their original research grow from the experience by improving their public speaking skills, networking with professionals and experts in their fields, listing a presentation on their resume and possibly even winning a cash award.

Each of the three sponsoring societies will select one student paper (graduate or undergraduate) for oral presentation. Additional abstracts will be accepted for poster presentations. All presenters will receive certificates of recognition and appreciation, as well as complimentary dinner. The three oral presenters will each receive awards of $100, while the three best poster presenters will each receive $50.

Guidelines and Submission Forms can be downloaded from the PGS website:

https://www.pittsburghgeologicalsociety.org/student-night.html

The Student Night Guideline document contains the formatting rules to be used in the abstract submission and also the rules to be followed for the presentations themselves when the time comes. The Student Night Abstract Submission Form is a two-page fillable PDF document consisting of a cover sheet with digital signatures by the student and faculty mentor and an abstract describing the research project. A letter of support for the project must be submitted separately to PGS by the faculty advisor of the project.

Abstract submission forms and letters of support should be emailed to the PGS Program Chair, Dr. Daniel Harris, at Harris_D@calu.edu.

Some additional links that students may find helpful in putting together their abstracts and presentations:

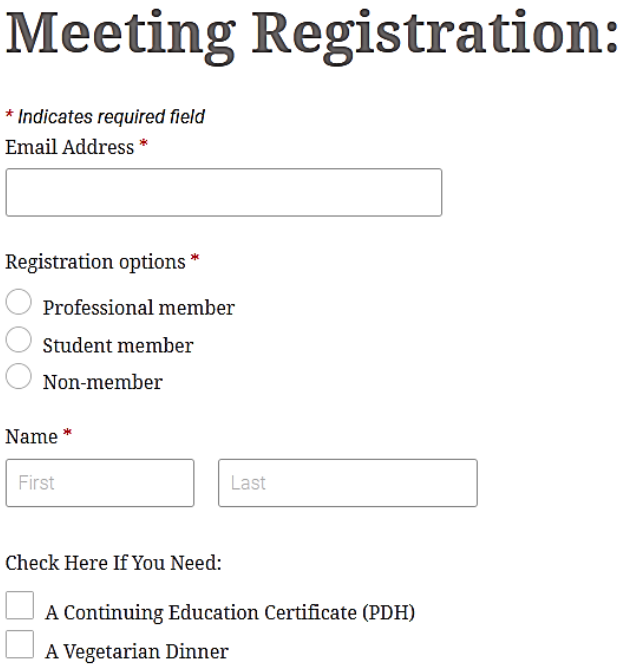
- The American Geophysical Union's oral presentation style guide with advice on best practices. http://www.projectionnet.com/Styleguide/presentationstyleguide.aspx
- Dennis Jerz's Tips on Oral Presentations. Dennis Jerz is an English professor at Seton Hill, and he's stellar at what he does. Do read and retain his coaching on oral presentations: it's top-notch. https://jerz.setonhill.edu/writing/technical-writing/oral-presentations-tips/
- Rice University's site on oral presentations skills. There are sample clips to show you what to do (and not do) in your oral presentation. http://www.owlnet.rice.edu/~cainproj/ih_presentation.html
- The National Institute of Health's Ten Simple Rules for a Good Poster Presentation' and 'Ten Simple Rules for Making Good Oral Presentations' https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1876493/

The deadline for abstract submissions is March 26, 2021 by 5:00 PM. Acceptance decisions will be announced by PGS, ASCE & AEG in early April.

PROFESSIONAL DEVELOPMENT HOUR (PDH) CERTIFICATES

PGS issues one PDH unit for those attending meetings and requesting a certificate. Virtual meetings complicate matters a bit. Please be sure to enter your full name with the email address where you want the PDH certificate sent when registering to ensure accurate recordkeeping.

Don't forget to check the PDH box on the website form.



PGS ANNUAL NOMINATIONS & ELECTIONS

Spring is on its way, and we hope you find this a good time to consider becoming more involved in the future of the Pittsburgh Geological Society. As the PGS monthly meetings carry on virtually during these COVID times, our officers and Board members also continue to meet virtually on a monthly basis to plan and provide for our membership's educational and professional needs. Between now and April we look to fill a ballot with qualified and energetic members for our May election.

If you have no previous experience in participating in governing a professional society then you may want to consider running for one of the three Director-at-Large positions that are filled every year by the Society. In this position you will assist the officers and committee chairs in the monthly functions of the PGS. The Director-at-Large position is a 2-year commitment and requires regular attendance at the Board meetings that are typically held one hour prior to the social period of each monthly meeting.

If you are a past officer/board member, you are always welcome back. Previous experience is very useful at our Board meetings, whether you want to return as an officer or take the gradual approach as a Board member.

If you are an active professional member of the Society and have an interest in being a candidate, or know of a member that you think would be a good candidate, please contact Ray Follador, Nominations and Elections Committee Chair, at geodawg@comcast.net or (724) 744-0399. A list of all candidates will be announced at the April meeting with the election to be held at the May meeting.

THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES

The Borough of Bellevue, on the Ohio River in Allegheny County, was originally designated part of the "Depreciation Lands" - land offered to Revolutionary War soldiers *in lieu* of payment for their services. Hugh Henry Brackenridge and James Robinson were the first landowners in the area, having acquired their properties in 1792 and 1799, respectively. Soon, other settlers arrived but the area remained rural until after the Civil War, with a few scattered farms and country houses strung out along what is now Lincoln Avenue, a main road between Pittsburgh and Beaver.

Historical photo of the house where J. J. East, the man who named Bellevue, lived. The house formerly sat on the corner of Florence and Lincoln Avenues in Bellevue.

Following the Civil War, transportation improvements made it possible for many of the people who lived and worked in the burgeoning city of Pittsburgh to move farther away, allowing them to escape the overcrowding (and, let's face it, the influx of what some people at the time considered "undesirable" immigrants) that came with it. The community was then located in the southwestern part of Ross Township, but following disputes over the lack of improvements, it seceded and became incorporated in September 1867. At that time, Bellevue had a population of 300, the exact minimum number for incorporation. An early resident of the area named J. J. East, who was a linguist, suggested the town's name. It is French for "beautiful view". The town's post office, originally known as Robella, was renamed Bellevue in 1887.

DID YOU KNOW . . . ?

The science of Geology as a discipline was created to find and exploit Earth's resources. Although William Smith's groundbreaking (no pun intended) 1815 geologic map was a graphical method of depicting where certain rock layers occurred, and his work was a catalyst in the development of our current understanding of geologic time, at its roots, the study of the Earth was, and to some extent, still is linked to the search for resources.

Over the past 200 years, however, things have changed a lot. The study of the Earth, better described as Earth Sciences, has evolved to be more than just the search for fossil fuels, metals, and water. Now, geologists also study the planet to better

Students need to be trained less about finding resources and more about assessing the potential for, and mitigating, things like the damage from a landslide that occurred on Route 30 in East Pittsburgh in 2018.

understand natural hazards, to determine the planet's climate history and future, to understand the connection between the biosphere and the lithosphere, to hypothesize about the origin of life, and to just learn more about the planet and places where we live.

Yes, we're still finding and extracting resources, but it's not without its consequences. Scientists have linked the burning of fossil fuels to climate change. Mining has done significant damage to delicate ecosystems and led to the exploitation of people and nations while empowering and enriching others. We are only now realizing that the phasing out of fossil fuels will be necessary to stop, or at least mitigate the effects of climate change. As a result, all those lucrative jobs in the oil industry that have sustained many geology programs at colleges and universities are going away.

For many geology students, the idea of a stable and lucrative career in the fossil fuels industries had a lot of appeal. Where else could someone with only a bachelor's or master's degree expect to start a job earning close to or more than $100,000 per year? But it certainly isn't going to be the case soon. Geology needs to rebrand and retool because the term Earth Sciences is a much better description of what people who study the Earth do today. It is about connecting all the processes that happen on and within our planet; showing how we can better understand the consequences of resource use; comprehending and guarding people from the outcomes of climate change and natural hazards; finding the resources needed to propel the use of green energy.

Yes, students still need to know about rocks and minerals, plate tectonics, how the interior of the Earth works, to see rocks in the field, and to understand what they mean. However, students also need to be comfortable with big data and with geographic information on a global scale. They need to know how to do lab analyses and how to interpret whether the data collected are robust and reliable. The days of making a career from merely mapping the Earth's surface are disappearing. In addition, students need to understand how the Earth impacts lives by comprehending the economic, anthropologic, and social consequences of both natural and human-driven Earth processes. As a result, many college and university Geology departments, need to rethink their focus and curriculum on both graduate and undergraduate levels. Sometimes disciplines tend to stagnate, especially when so much money was coming from such a specific part of the field.

Many institutions of higher learning are eliminating their geology programs due to low enrollment, which in turn may reflect that these programs aren't adjusted to what modern students want from studying Earth Sciences. They want careers apropos to sustainability, renewable energy, climate change resilience, natural disaster preparedness, and human/Earth interactions. This is not to say departmental curricula should abandon the central tenets of an Earth science education. Instead, they should seriously consider what it will mean to be an Earth scientist in future years. If Geology/Geosciences/Earth Sciences doesn't adapt, the discipline will soon become like the dinosaur – an extinct entity.

https://www.discovermagazine.com/planet-earth/geology-is-at-a-crossroads

A team of scientists from Ireland has discovered new information on the processes that form a rare earth-bearing mineral that is very important for its use in the green energy and technology industries. Rare earth elements (REEs) are crucial because

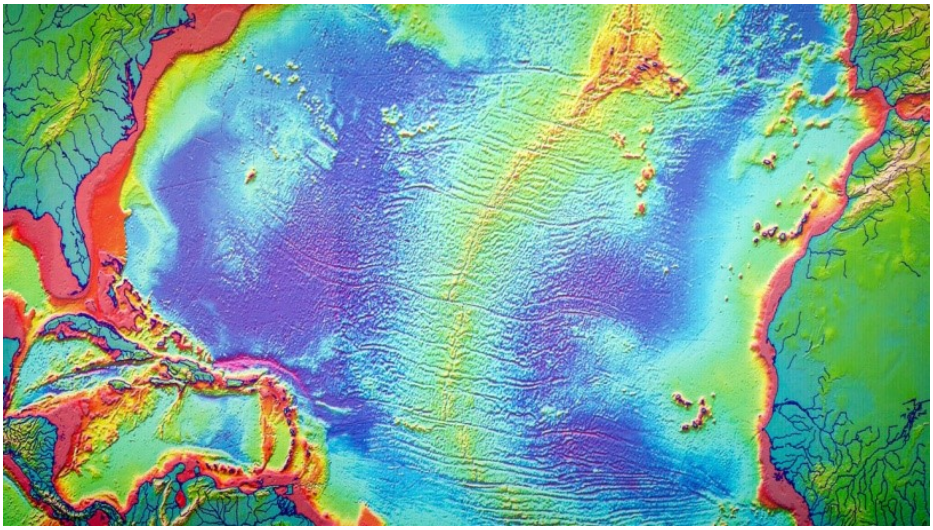
Bastnäsite, an important rare earth-bearing mineral, is sometimes found as a residual mineral in bauxite deposits in karst terrains.

of their ability to form small, very powerful magnets necessary for smart devices such as cell phones and tablets, low-carbon energy generation such as wind turbines, and even hybrid vehicles. And since there are no substitute alternatives to these, the discovery of additional resources has important economic implications. Most REE resources are developed from carbonatite deposits, the largest known of which is the Bayan Obo in China. Scientists are still debating how and why REEs form because of their complex mineralogy, element composition, and geologic history. More than 250 REE-bearing minerals are known, but only three are economically viable and exploited commercially. The fact that the world needs more REEs impelled the team to study the geochemical behavior of these valuable elements. They wanted to know more about REEs, such as how and why they form.

Bastnäsite, the focus of the team's study, is arguably the single most valuable mineral for REEs in the world. In Bastnäsite (cerium fluoro-carbonate – $CeCO_3(OH,F)$), cerium is the major REE ion, but other REEs such as lanthanum and yttrium often substitute for cerium in the formula. When they considered how water containing REEs interacts with calcite, the team discovered a new route to the formation of bastnäsite. The team's discovery of the crystallization pathway revealed that in some REE-bearing deposits bastnäsite could originate as a simple result of how calcite interacts with REE-rich fluids. It's not the only way that bastnäsite forms, but the team's discovery is especially important because calcite is both ubiquitous and the most stable calcium carbonate found in nature. As a result, calcite should be possible to support the formation of bastnäsite, under the proper conditions of course.

https://www.greencarcongress.com/2020/12/20201129-ree.html

Seafloor spreading and subduction are relentless processes on Earth, but the rate at which these plate tectonic processes operate has changed over time. Beginning about 15 ma ago (Late Miocene), ocean crust production declined by 1/3 over a 10 ma period to a pace that is more or less continuing today, according to a recent study by a team of geophysicists. Previous studies hinted at a slowdown, but nothing before had shown that the process was in such a steep decline. The slowdown also was widespread – crust production either slowed down or remained steady at 15 of the 16 ocean ridges. In addition, the effect of this slowdown may have been very important for Earth's climate because a dramatic decrease in the pace of plate tectonics over such a short time period would also decrease the amount of CO_2 gas from volcanism. As it turns out, there was also a 50°F temperature decrease in the late Miocene. That's when the Antarctica ice sheet began to grow after a long period of warm climate.



A new study indicates that the extrusion of magma to form new ocean crust at midocean ridges started to slow down 15 million years ago, which may have helped reduce global temperatures.

Previous research had reported new high-resolution data from the Atlantic and Indian oceans that showed these ocean ridges spread slowly. New research has now assembled a corresponding high-resolution record for the faster and more complex seafloor spreading in the Pacific Ocean. With the additional data, the

slowing movement became apparent immediately. The deceleration occurred first in the Pacific between 12 and 13 ma ago, then 7 ma ago in the Atlantic and Indian oceans.

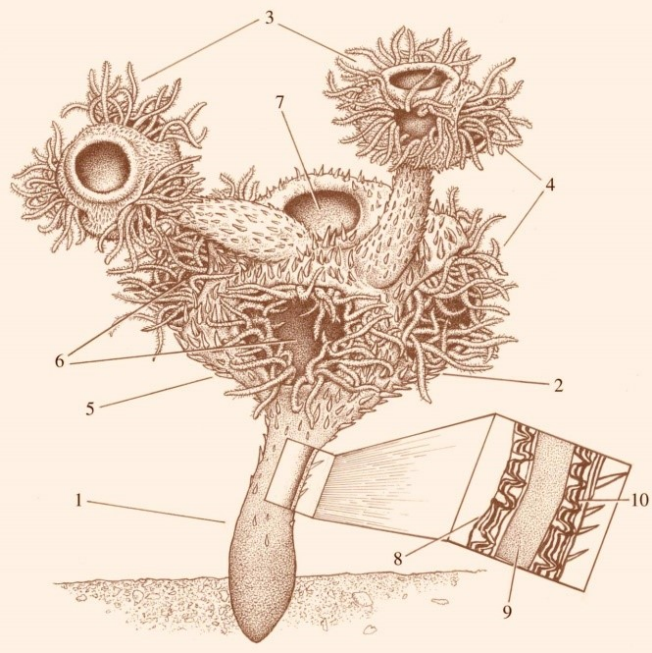
The "why" of this phenomenon is still being debated. It is possible subduction stopped pulling on the oceanic plates as intensely during this time; the plates decreased in thickness and density. It is possible the subduction zones shrunk in length, thereby reducing their pull. It is also possible that the subduction zones changed their orientation, causing the slabs to meet more resistance as they plunged into the mantle. It is possible that a slab broke and changed the flow of heat inside the mantle. Since changes in one plate affect all the plates, that would have altered the glide of the tectonic plates overhead.

In addition to lowering CO_2 in the atmosphere, the slowdown of plate tectonics would have reshaped Earth's surface. Less seafloor volcanism means smaller midocean ridges and larger ocean capacities, which in turn means lower sea levels. Sea level would have fallen by 72 feet, exposing a lot of new land surface on the continental shelves. Less volcanism also means Earth would have shed 1.5 terawatts of internal heat, about the same energy as would be produced by 1500 nuclear power plants. Although such a heat flow decline would not have a big effect on atmospheric temperatures, it makes assumptions about constant heat loss across geologic time suspect. There is still much research to be done but, when these new data are taken into consideration, it becomes clearer than ever that there is nothing constant about plate tectonics.

https://www.sciencemag.org/news/2020/12/slowdown-plate-tectonics-may-have-led-earth-s-ice-sheets

A new skeletal multicellular animal has been discovered that provides a link between the Ediacaran and Early Cambrian metazoans. While doing fieldwork in Namibia, a team of paleontologists unearthed well-preserved fossils of a metazoan called *Namacalathus hermanastes* that lived about 547 ma ago during the Ediacaran.

Until recently, we knew very little about the origins of animals that evolved during the "Cambrian explosion" because well-preserved fossil evidence was critically lacking. Charles Darwin was perplexed because there was no direct evidence of the origin of animals that suddenly seemed to emerge at that time. This is often referred to as Darwin's dilemma. Before the new discovery, it was difficult to find links between Cambrian animals and earlier animals because their soft tissues almost always break down over time. It is the soft tissues that provide vital clues about the animals' ancestry.



Artist's reconstruction of a living *Namacalathus*: 1 – stem; 2 – parental cup; 3 – daughter cups; 4 – hollow ciliated tentacles; 5 – spines; 6 – lateral lumen; 7 – central opening; 8 – inner skeletal layer, foliated with columnar microlamellar inflections; 9 – internal (middle) skeletal later, organic rich; 10 – external outer skeletal layer, foliated with columnar skeletal inflections

By utilizing X-ray imaging on the new specimen, the research team found some of the animals' soft tissues had been perfectly preserved inside the fossils by pyritization. Although previously known only by its skeletal remains, the newly discovered *Namacalathus hermanastes* fossils provided the team with a way to compare the soft tissues of the Ediacaran animal with those in animals that evolved later. This resulted in their finding

that *Namacalathus hermanastes* was an early ancestor of species that appeared during the Cambrian explosion such as certain types of worms and mollusks. These exceptional fossils provide a glimpse into the biological affinity of some of the oldest animals and help trace the roots of the "Cambrian explosion" and the origin of modern animal groups. It is possible that such preservation will open up many new avenues of research into the history of life.

http://www.sci-news.com/paleontology/ediacaran-early-cambrian-metazoans-09242.html)

The United Kingdom (UK) has its first geothermal power plant in operation, along with a 10-year deal to sell electricity to 10,000 homes. The plant, located in Cornwall in southwest England, is generating power by mixing water down two wells, the deepest of which is 3 mi (4.8 km) deep. Both wells pass through the Porthtowan fault zone where they encounter hot water and granite. The United Downs Deep Geothermal Power Project, which was funded by a private/public partnership throughout the 2010s, is set to be fully operational next year.

Photograph of a rig drilling a deep geothermal well in Cornwall, England.

Geothermal Engineering Limited, the owners of the plant, said that while it is an exciting project, it is still very much in the early days of the plant development as well as any future geothermal developments. Ecotricity, the world's first renewable energy company, has signed a deal to buy three megawatts of geothermal power for the area. The founder of Ecotricity described geothermal is an exciting form of energy and stated that it currently is not being used in the UK. He said the company is happy to be part of the project, adding geothermal power to its customers' energy mix and playing a big role in the nation's plans to decarbonize the country. Another buyer, a local distillery, is preparing a £10 million ($14 million) contract to age nearly 1.32 million gallons (500,000 liters) of their rum using a geo-heated/powered biome.

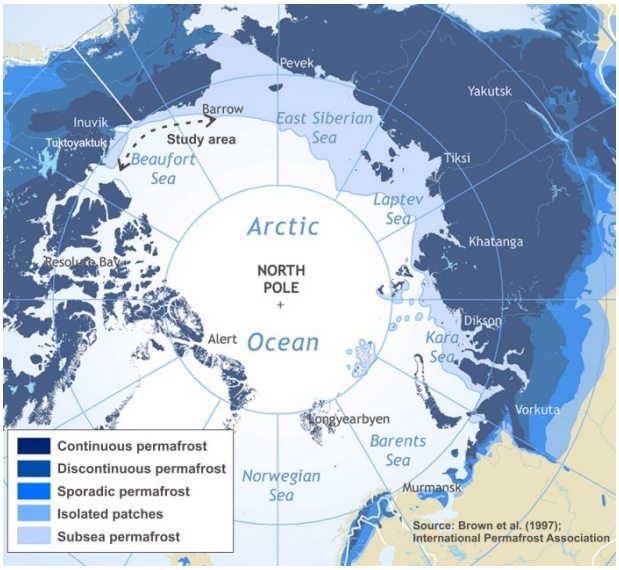
Some might question why anyone would go through all the trouble and expense of drilling a three-mile deep hole when solar-panel and wind-turbine technologies are advancing so quickly. But geothermal energy systems are always running and don't rely on the weather. There might be a lot of wind in Cornwall, but sunshine is not constant by any means. There is a huge amount of energy beneath the Earth's surface. The main limiting factors in utilizing it are the costs for drilling and the expense of connecting to the national grid on the surface. Yet Ecotricity is predicting growth in the geothermal capacity of the British Isles. The company suggested that as much as 10% of the nation's power supply could be generated by geothermal energy.

https://www.goodnewsnetwork.org/cornwall-site-of-the-uks-first-geothermal-power-plant/

According to the USGS, millions of tons of carbon became tied up in organic matter and CH_4 trapped in subsea permafrost, and covered by 390 ft (120 m) of seawater on the continental shelf under the Arctic Ocean toward the end of the Paleolithic ice age about 18,000 to 14,000 years ago. Some of this thaws out and oozes to the surface every year. Unfortunately, because the sediment occurs in what is basically an inaccessible location, only a small amount of patchy data exist on how much CO_2 and CH_4 lie buried there and how quickly those gases are escaping into the ocean and atmosphere above. Some scientists consider this greenhouse gas reservoir to be a ticking time bomb that could suddenly spew into the atmosphere, triggering a

climate catastrophe. New research suggests a different scenario, however – rather than a sudden release, these gases have been slowly and steadily oozing from the permafrost for centuries. Although anthropomorphic climate change could make the situation worse by accelerating the rate of release, the researchers conclude that any acceleration would occur over several centuries, not decades or years as has been suggested.

The research team attempted to compile a complete picture of the subsea permafrost using all of the data currently available. They also asked 25 permafrost experts to estimate how much organic carbon is hidden in each specific layer of subsea permafrost. This allowed the team to attain a more detailed picture of the ecosystem.



Map of the Arctic Ocean showing the locations of known permafrost. Subsea permafrost is shown in the lightest blue color.

They estimated that the permafrost currently holds about 60 billion tons (544 metric tons) of CH_4 and 560 billion tons (508 metric tons) of organic carbon. They also estimated that, each year, about 140 million tons (128 metric tons) of CO_2 and 5.3 million tons (4.8 metric tons) of CH_4 escape from the permafrost into the atmosphere. That's approximately equal to the carbon footprint of Spain.

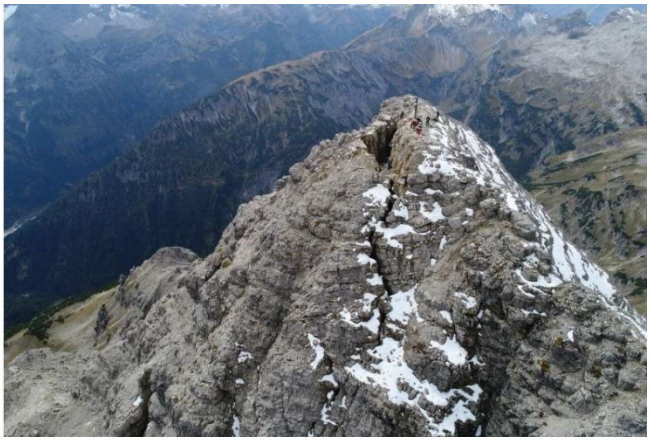
The team noted that, due to the scarceness of data, these estimates continue to be highly uncertain. They also concluded that a lot of the greenhouse gas emissions began after the Last Glacial Maximum when the ice sheets were at their greatest extent, rather than being driven mostly by recent human activity. However, anthropogenic changes could still drive up these emissions several hundreds or thousands of years from now. In fact, experts expect the rate of greenhouse gas emission from subsea permafrost to increase significantly over the next 300 years if anthropogenic carbon emissions continue to occur. The team suggests that, if emissions continue to rise throughout the 21st century, the Arctic permafrost would release four times more greenhouse gas than if emissions began declining by the end of 2021 and reached net-zero by 2100.

If we ignore subsea permafrost in our climate change models, we run the risk of misjudging the amount of greenhouse gas emitted to the atmosphere, skewing our targets for reducing emissions. Additional research into subsea permafrost over the next five or 10 years will hopefully help fill any gaps in our knowledge, providing more assurance of how much carbon is down there and how much is leaking out. Factors such as the extent of sea-ice cover might also affect how much gas leaks into the atmosphere because the ice can trap the gas underneath.

https://www.usgs.gov/center-news/subsea-permafrost-and-associated-methane-hydrate-us-arctic-ocean-margin

The Hochvogel is a 8,504-ft-high (2,592-m-high) mountain in the Alps with the border between Germany and Austria running over the summit. The entire summit of the Hochvogel is divided by a fracture 16 ft (5 m) wide and 98 ft (30 m) long that continues to open up by up to 0.2 in (0.5 cm) per month. The southern side of the mountain has already dropped by several feet and at some point, when it finally fails completely, it will release up to 340,000 yd^3 (260,000 m^3) of limestone debris into Austria's Hornbach Valley, the equivalent of about 260 houses. When this will occur is hard to predict by conventional methods. Researchers in Potsdam and Munich are using seismic sensors that give them insight into the probability of an impending rock slide. It should provide them with a timely warning, even if houses are not threatened directly at the site.

Large rock slope failures happen all the time, playing an essential part in the long-term evolution of landscapes. This makes them fundamentally important in land use planning and hazard mitigation. Since they occur suddenly and proceed rapidly they are difficult to study. It is obvious that mechanical load or temperature variations create stress within the rock. This stress is released in processes of disintegration. Fractures develop at different spatial scales. At some point, the structure becomes unstable enough to ultimately break apart. Although the failure phase of this scenario is well known, there are still many gaps in our knowledge about their longer-term precursors. Part of the reason for this is that the placement of permanent equipment for measurement in high mountains is both difficult and expensive. Continued monitoring is often done using remote sensing data or sensors that collect only point data.



The summit of the Hochvogel in the Alps has a gash that is 16 feet wide by almost 100 feet long. Eventually, part of the peak will fail and slide into the valley below.

Neither of these approaches has been able to record the processes inside a volume of rock in sufficient temporal and spatial detail, nonstop, and in a larger spatial context. In order to understand when and why the unstable rock mass will become mobile, a team of researchers installed a network of six seismometers at the summit, each 100 to 130 ft (30 to 40 m) from each other, which recorded the subtle vibrations of the peak between July and October, 2018. The vibrations were caused by wind and numerous small quakes of the Earth's surface, and the summit's frequency is determined by factors such as temperature, rock stress, and material weakening.

In the summer of 2018, the researchers measured a recurring frequency pattern where, over a period of about a week, it rose repeatedly from 26 to 29 Hz, then dropped back to its original value within less than two days. As the frequency dropped, the sensors recorded an increased rate in crack signals, which are known to occur when rock is being torn apart. This cyclic increase and decrease of stress, known as stick-slip motion, typically is a precursor of large mass movements. The decisive factor is the length of the observed cycles. The shorter they become the more important they are as a hazard indicator. This seismic approach is allowing researchers, for the first time, to continuously sense, record, and process the cyclical phenomenon in close to real time.

Another factor came to their attention during the four months they made their measurements. They noticed the build-up and release of stress was clearly visible in the first few months after snow melt, but it disappeared in late summer during the drought of 2018. Apparently, the summit ran short of an essential lubricant during the summer – water. By then, only diurnal frequency played a role as the rock contracted during the cold night hours. Fissures became larger and the connection with solid rock became less rigorous, resulting in a decreasing vibration frequency. In the heat of the sun, the rock mass expanded, closing small fissures and causing a rise of the vibration frequency.

The researchers are continuing to investigate how these cycles interact and how the chilly winters will affect the deep, water-filled crevices. They will continue to investigate the consequences of rock mass activity at the summit for the south-facing hillslope using a larger seismic network. Fortunately, access to the peak in the study area has already been closed for years due to imminent risk of falling rock.

https://phys.org/news/2020-12-melody-alpine-summit-falling.html

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Fun Fact Having Nothing to Do with Geology

The water droplets forming a small cumulus cloud weigh more than a mid-size car.

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