PITTSBURGH GEOLOGICAL SOCIETY

APRIL 18, 2018

Social hour	**6:00 PM**
Dinner	**7:00 PM**
Program	**8:00 PM**

Dinner costs
$30.00 per person
$10.00 student member

Reservations
Email your name and number of attendees in your party to: pgsreservations@gmail.com

You can also reserve and pay via PayPal at: https://www.pittsburghgeologicalsociety.org/

Location
Foster's Restaurant
Foster Plaza Bldg. 10
Green Tree PA

The 16th Annual Student Night

Co-sponsored by the Association of Environmental and Engineering Geologists (Greater Pittsburgh Chapter) and by the American Society of Civil Engineers (Pittsburgh Chapter)

Deadline for reservations is noon on Monday, April 16.

STUDENT ORAL PRESENTATIONS

ASCE Judges' Selection for 2018

LIDAR-BASED LANDSLIDE INVENTORY AND PROBABILISTIC SUSCEPTIBILITY MODEL, PRESTONSBURG 7.5-MINUTE QUADRANGLE, KENTUCKY

CHAPELLA, HANNAH C., Department of Geology, Kent State University, Kent, OH 44242

The Prestonsburg quadrangle in the Cumberland Plateau of eastern Kentucky is a forested and landslide prone area dominated by narrow ridges, steep slopes, and, in many places, terrain disturbed by past and current coal mining. The regional bedrock geology consists of flat-lying Pennsylvanian shales, sandstones, siltstones, and coals; the vegetation is temperate deciduous forest sustained by average annual precipitation of 49 inches. In collaboration with the Kentucky Geological Survey, I undertook a pilot project to develop a LiDAR-based landslide-mapping protocol and create landslide inventory and susceptibility maps of the Prestonsburg 7.5-minute quadrangle. I used arcuate head scarps, bulging toes, displaced drainage paths, and hummocky topography to define landslides from LiDAR imagery. Bedrock geology maps, topographic curvature, topographic roughness, and aerial photographs were used to supplement the LiDAR-based mapping. In all, I mapped 431 landslides, including 293 translational slides, 76 rotational slides, and 62 complex slides, along with 22 post-LiDAR landslides. The dominant mode of slope failure is translational landslides which tend to occur along the colluvium-bedrock contact as pore pressures increase after rainfall. I used the physics-based probabilistic computer code PISA-m to create a preliminary susceptibility map, which indicated that the southern portion of the quadrangle has a greater potential for failure. Comparing the post-LiDAR landslides and susceptibility map, 86% of recent landslides plotted as having 50% or greater probability that the factor of safety is less than one. If successful, my protocol may be implemented statewide and results made available online, serving as a resource for residents and professionals.

PGS Judges' Selection for 2018

OLIVINE CRYSTAL SIZE DISTRIBUTION IN THE BLACK STURGEON SILL, NIPIGON, ONTARIO

HONE, SAMUEL V. and ZIEG, MICHAEL J., Department of Geography, Geology, and the Environment, Slippery Rock University, Slippery Rock, PA 16057

Recent years have seen widespread acceptance of the idea that igneous intrusions are often emplaced in multiple phases or pulses. To test whether textural data could be used to distinguish between these pulses, we investigated the use of crystal size distributions to discriminate between distinct populations of olivine in the olivine-rich zone of the Black Sturgeon sill near Lake Nipigon, Ontario. We performed this analysis by collecting images from 42 samples throughout the olivine zone and stitching them together into large mosaics. After manually tracing olivine crystals, we then entered the list of crystal sizes into the software package CSDCorrections 1.5 to calculate the distribution.

Using the slope and intercept of crystal size distributions, along with cluster analysis, we can identify separate populations of olivine in the olivine zone of the Black Sturgeon sill. While we have not found any consistent variation within groups, the breaks between the populations are sharp and coincide roughly with compositional changes. We interpret these breaks as evidence of the episodic emplacement of the Black Sturgeon sill. Crystal size distributions have proved an effective

complement to other methods in identifying discrete magma pulses in this sill. The episodic nature of magma emplacement in the Black Sturgeon sill also raises the possibility that other layered mafic intrusions formed by a similar process.

AEG Judges' Selection for 2018

DETERMINING FACTORS AFFECTING FLOW RATE FROM LEGACY WELLS IN INDIANA, PENNSYLVANIA

JOHNSON, ERIN H., and HOVAN, STEVEN A., Department of Geoscience, Indiana University of Pennsylvania, Indiana PA 15705

In Pennsylvania, estimates suggest that as many 400-700 thousand wells have been drilled in the past century and a half. Many of these older "legacy" wells were abandoned or orphaned prior to the development of the modern regulatory framework and thus have an unknown closure status and may pose environmental risks related to leaking gas or fluids. This study is aimed at trying to determine atmospheric and/or environmental variables that may cause fluctuations in gas emissions from leaking wells. Data were collected from a specific well in Indiana County, Pennsylvania, that is leaking variably. Discrete gas samples show that methane comprises more than 95% of the leaking gas and stable isotope ratios are consistent with thermogenic sources. Regular intervals of emission flow rate data were also collected and compared to a variety of meteorological conditions. Short term (hourly to daily) flow rates are significantly affected by atmospheric pressure and slightly affected by the Moon's gravitational pull on the Earth based on its position in each phase. Long term factors (monthly or yearly) may include precipitation and its impact on the water table or subsurface mine flooding. This study can help determine the causes of flow rate changes on one specific well which can then be used to help estimate regional emissions.

STUDENT POSTER PRESENTATIONS

DETERMINING THE PALEOGEOGRAPHICAL ORIGIN OF *ALLOSAURUS FRAGILIS* FROM WITHIN THE CLEVELAND LLOYD DINOSAUR QUARRY (PRICE, UTAH) USING BIOGENIC APATITE $\delta^{18}O$ VALUES

NICOLE LEES, Department of Geoscience, Indiana University of Penn., Indiana PA 15705

THE ART OF MAKING A 3D PRINT: THE COMPARISON OF 3D IMAGING TECHNIQUES

ERICA LOUGHNER and JORDAN OLDHAM, Department of Geology, Cedarville University, Cedarville OH

IMPACTS OF URBAN ENVIRONMENTS ON MARSH RUN, INDIANA COUNTY PA

JILLIAN MATHEWS, Department of Geoscience, Indiana University of Penn., Indiana PA 15705

PGS Nominations & Elections – Call for Candidates

April is a great time to consider becoming more involved in the Pittsburgh Geological Society. If you are a professional member of the Society and enjoy attending our monthly meetings, please consider taking a position on our Board or as an officer. We are looking to fill our ballot with qualified and energetic members for our May election.

If you have no previous experience in governing a professional society, then you may want to consider becoming 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 Society. It is a great way to contribute to your Society while getting acclimated to its function. Membership on the Board helps groom our future officers. The Director at Large position is a 2-year commitment and requires regular attendance at the Board meetings held one hour prior to the social hour of each monthly meeting.

If you are a past officer or board member, we want you to know you are always welcomed back. Previous experience is very useful at our Board meetings whether you want to come back 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**, Chair or the Nominations and Elections Committee, at geodawg@comcast.net or (724) 744-0399. A list of all candidates will be announced at the April meeting.

Preview of our Next Meeting

PRESIDENT'S STATEMENT

Because of the field trips!

Being a student of the Earth Sciences is exciting. If you are currently a student or were years ago, do you remember how interesting it was to learn how rocks were formed for the first time or how to read the story within the rock record? For me, as a geology student in the early 80's, times were very different, there were no cell phones, tablets, fast computers or hand held GPS units. Notes were elaborately written on the chalk board and the technology in the classroom consisted of microscopes, slide projectors and overheads.

Today, students have a plethora of technological devices to assist them in their learning. When faced with new terms in the language of geology, one can easily look it up on a smart device and get an instant response. Despite these differences the content and learning objectives have remained relatively the same. We still conduct field research in essentially the same way and those important fundamental principles proposed by the founders of our science guide us as practitioners.

What was it that drove all of us to choose this career? For many of us, it was a major that provided the opportunity to be outside. The best part about being a geology major is the field trips! I became a geology major because all my friends were going on field trips and I wanted that experience too! I see that same excitement in my students when I even slightly mention the possibility of going into the field and their faces light up. The landscape is our laboratory and where observations are used to make interpretations and solve problems. One of the best parts about being geologists is that we continue to learn throughout our career by going on field trips and spending time in the field to learn more.

There are other characteristics that seem to connect us in a way unlike other science disciplines. Geologists and geology students are not only interested in spending time outside, but we seem to dress alike as well. Have you ever noticed, when at a professional meeting or in the office, that most geologists dress like we are ready to go into the field at any time? Day to day, many of us carry the essential outdoor equipment, like backpacks, water bottles, and our hand lenses in our back pocket. We have all spent long hours in the college rock lab forming life-long friendships as we worked on a structure problem or stared into the microscope. All geologists have a curiosity of the world and interest in solving problems using critical thinking. The relatively small geology community is laid back and most geologists are sociable and friendly. And oh, did I mention that one of the best parts about being a geologist are the field trips. Geology is a field of lifelong learning!

This month we don't just celebrate student research success, but we celebrate the student in all of us! We celebrate our love for the Earth Sciences and the endless possibilities for a bright future.

I would like to acknowledge the corporate sponsorship from Stahl Sheaffer Engineering, LLC as well as a recent matching donation to PGS from Battelle. We appreciate their commitment and support for our 2018 initiatives.

We look forward to seeing you at the meeting, and hope some of you will consider stepping forward to serve as PGS officers or board members in the coming year.

Happy Spring,

Tamra

Tamra Schiappa

IN MEMORIAM

PGS Honorary Member

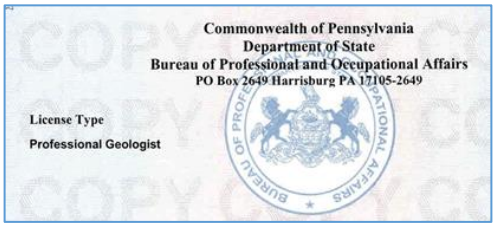
PAUL C. WUENSCHEL

It is with great sadness that we announce the loss of long-time PGS Honorary Member Paul Wuenschel, who passed away at age 96 on March 10, 2018. Up until a few years ago, Paul attended PGS meetings often, and never failed to greet old friends with a smile and a cordial greeting.

Paul was a geophysicist who did his graduate research at Columbia University from 1946 to 1952, measuring gravity anomalies along transcontinental traverses through South America and interpreting their geological significance. He came to Pittsburgh to work as a geophysicist at Gulf Research and Development Lab in Harmarville in 1955. Among other ground-breaking work, he initiated some of the very first studies of computer seismic simulations and was one the first geophysicists to use Vertical Seismic Profiling (VSP), with data gathered from borehole measurements.

Paul Wuenschel's research on borehole sensors and signal processing was recognized by the Society for Exploration Geophysics with the Best Paper Award in 1976. In addition to his service to PGS, Paul also served on the SEG's Distinguished Lecture and Research Committees and chaired the SEG's Reviews Committee for many years. He became an SEG Honorary member in 1984, a year after retiring from Gulf Research and Development.

PGS Professional Development Hours for PGs


Commonwealth of Pennsylvania
Department of State
Bureau of Professional and Occupational Affairs
PO Box 2649 Harrisburg PA 17105-2649

License Type
Professional Geologist

Licensed Professional Geologists may use PGS monthly lectures as a one-hour credit toward their state requirement for continuing education to renew their licensure. If you attend dinner before the talk, your certificate of attendance is provided at no cost to you.

If you plan to attend only the talk, rather than the full meeting with dinner, we ask for a $10 contribution to cover the costs of printing the certificate. It would be a great help to our treasurer if you could pay in advance using PayPal. For more details on reserving and paying for a talk-only certificate, please email Kyle Fredrick at pgsreservations @gmail.com.

MARK YOUR CALENDARS FOR A POTENTIAL PGS SPRING FIELD TRIP

The schedule is still being finalized for the spring field trip on Saturday May 26 (tentative). Keep an eye on the PGS website for final details and information on how to sign up for a spot.

GEOLOGY OF THE EARLY IRON INDUSTRY IN FAYETTE COUNTY, PA

Please note that this is the current proposed trip itinerary. Locations, times and order of stops may change as our plans are firmed up. Right now, we are shooting for a date of Saturday May 26 but nothing is set in stone. You should monitor the newsletter and websites for updates and (later in the spring) a registration/payment link.

Meet at Century III Mall, West Mifflin. Rent van(s) nearby. Drive south on PA 51 to Uniontown. Merge onto US 119/40 bypass and follow US 40 east toward and up Chestnut Ridge.

Stop 1: Scenic Overlook: This pull-off near the summit of Chestnut Ridge provides us with a chance to briefly discuss the geology of the area and the early iron industry in western Pennsylvania.

Leave Stop 1 and continue east on US 40 to Wharton Furnace Road (SR 2003). Drive south to Stop 2.

Stop 2: Wharton Furnace: This is one of about 20 charcoal blast furnaces that operated in Fayette County in the early 1800s. We will discuss the process of smelting pig iron from local iron ore (siderite), and the geology of the material needed to erect the furnace and create a useful product.

Drive west on Shephard Road to Skyline Drive. Drive north on Skyline Drive about 500 feet and pull to the side of the road.

Stop 3: North Summit Gas Storage Well: We will discuss the geology of North Summit field, particularly the structure and stratigraphy of the reservoir (Middle Devonian Huntersville Chert).

Drive north on Skyline Drive to US 40. Drive west on US 40 to US 119/40 bypass. Follow bypass to PA 51. Drive north on PA 51 to intersection with Laurel Hill Road (to the right) and Keisterville Upper Middletown Road (to the left).

Stop 4: First Puddling Furnace Historical Marker: We will discuss the importance of puddling iron furnaces to iron and steel production in western Pennsylvania and the rest of the world.

Drive east on Laurel Hill Road and West Crawford Avenue to US 119 in Connellsville. Drive north on US 119 to intersection with PA 819. Drive south on PA 819 to West Overton Village.

Stop 5: West Overton Village and Museum: This is the birthplace of Henry Clay Frick, the multi-millionaire coal and coke magnate. Coal and coke are essential to the steel-making process. As a young man, Frick worked at the West Overton distillery where Old Overholt rye whiskey was originally produced (now produced at the Jim Beam distillery in Kentucky). The museum features life-size dioramas that highlight the industries of West Overton Village between 1800 and 1919. Displays include coverlet weaving, coal and coke production, and whiskey distillation. For a fee, you can sample Old Overholt.

Leave West Overton Village and return to US 119. Drive north on US 119 to I70. Drive west on I70 to PA 51. Drive north on PA 51 to Century III Mall. End field trip.

EVENTS OF INTEREST TO PGS MEMBERS

SOCIETY OF WOMEN ENVIRONMENTAL PROFESSIONALS
THREE RIVERS CHAPTER

Saw Mill Run Watershed Cleanup

When 21 Apr 2018
9:00 AM - 12:00 PM
Location James Street Parking Lot off Willow Avenue, Castle Shannon, PA

SWEP Three Rivers is proud to announce our first Public Service Event of 2018 – **Earth Day Stream Cleanup** – hosted by the Saw Mill Run Watershed Association. Volunteers are requested for this ***rain or shine*** stream cleanup event to remove debris, trash and all non-biological material from the Saw Mill Run. This is a family friendly event, however all minors must be accompanied by a responsible adult at all times. Arrive early for coffee and bagels.

Google Maps: https://goo.gl/maps/u6iuxc1td1p

Dress Code: Please wear weather appropriate attire, including long sleeves, pants, and water friendly footwear or hip waders*. Please bring work gloves* and a safety vest* if you have one.

NETL 2018 Subsurface Workshop in Pittsburgh

GEOLOGICAL EVENTS

SOCIETY OF PETROLEUM ENGINEERS

April 10, 2018 (5:00-8:00 PM)
Second Annual Poster and Pints Session

Cefalo's Banquet & Event Center, Carnegie PA

HARRISBURG AREA GEOLOGICAL SOCIETY

April 12, 2018
"Nitrates in Rural Groundwater Supply Wells not from Farming: An Unexpected Finding Based on Forensic Hydrogeology" by Mark W. Eisner, P.G. of Advanced Land and Water, Inc.

AEG Office 441 Friendship Road, Harrisburg PA

PITTSBURGH ASSOCIATION OF PETROLEUM GEOLOGISTS

April 12, 2018 – Student Night
"Allogenic and Autogenic Controls in Appalachian Basin, Middle Pennsylvanian Allegheny Formation, Central – Northern West Virginia". Segun Abatan, PhD candidate at WVU

Cefalo's Banquet & Event Center, Carnegie PA

ASSOCIATION OF ENVIRONMENTAL AND ENGINEERING GEOLOGISTS

April 12, 2018
"Attempting to bridge the growing gap between academic and applied geology: A personal odyssey." Dr. John Wakabayashi, 2017-2018 AEG Jahns Lecturer.

Penn Brewery, Pittsburgh, PA.

PENNSYLVANIA COUNCIL OF PROFESSIONAL GEOLOGISTS

May 2, 2018 (1:00 - 5:00 PM)
"Soil Science: An Overview of Principles, Practical Field Methodologies and Applications"

Toftrees Resort and Golf Club, State College PA

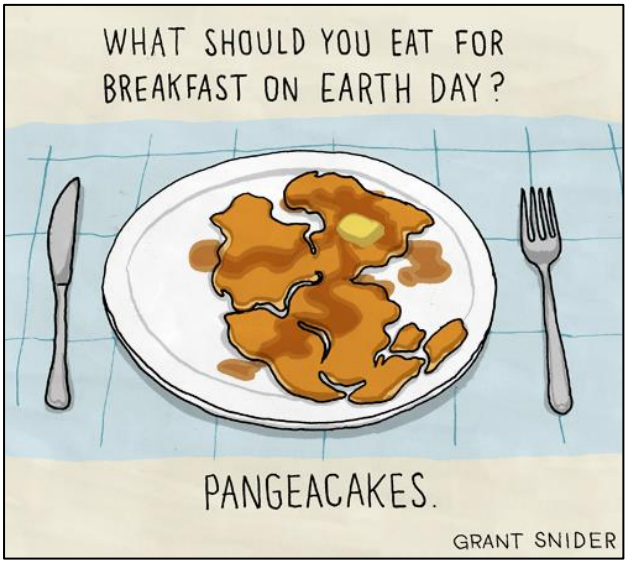
The Pittsburgh Geological Society is delighted to welcome the following new professional members to the society:

Dr. Jingan Wang
Geotechnical Manager
Stahl Sheaffer Engineering, LLC

2013 PhD in Civil Engineering from Washington State University.

Carl Medvid
Geotechnical Technician
Stahl Sheaffer Engineering, LLC

2015 MS in Seismic Geology from University of Akron.



HAPPY EARTH DAY ON APRIL 22!

PGS Geoscience Awards at the Covestro Science Fair

On March 23, 2018, Carnegie Science Center held the annual Covestro Pittsburgh Regional Science and Engineering Fair at Heinz Field. PGS members Wendell Barner and Tom Beatty donated their Friday to judge geoscience-related project. PGS sponsors two awards for the science fair, one for the Senior Division (High School) and one for the Intermediate Division (Middle School).

This year's recipients are: Senior Division - **Chelsea Carver** - Pine-Richland High School. Her science teacher/sponsor is Ron Schmiedel. Her project was on the abandoned mine drainage at the Mathies Mine in Washington County, PA. Abstract: "Twenty-five acid mine drainage samples were collected from the Mathies Mine runoff to determine if the Pennsylvania Department of Environmental Protection's remediation efforts have been successful following the mine's closure in 2001. Using the proxy of the inverse relationship of dissolved oxygen and iron concentrations it is apparent the man-made limestone embankments are having no effect when compared to data from over a decade ago. In addition, no other techniques such as phytoremediation were utilized to improve results. One runoff pool contained algae and it was there that the iron readings were lowest, so future analysis should be focused there. "

The Intermediate winner is **Helen Katyal** - Providence Heights Alpha School. Her science teacher/sponsor is Linda Cessar. Her project was titled "Take a Peek at What's in Your Creek". Abstract: "Water samples upstream and downstream from a local wastewater treatment plant were collected and evaluated for water quality parameters. The data were compared to limits set forth in the treatment plant's NPDES permit."

Chelsea Carver receiving her PGS Award packet from Wendell Barner

Helen Katyal receiving her PGS Award packet from Wendell Barner

PGS Educational Outreach at the Carnegie Museum

On March 09, 2018, Matt Brunner, an Earth Science teacher at Shady Side Academy and the 2018 AAPG Eastern Section Teacher of the Year, brought his Sixth Grade Earth Science class to the Carnegie Museum Section of Invertebrate Paleontology. Joining Albert Kollar, geologist at the Carnegie Museum (PGS Award Committee Chair) is board member (Director At Large) Ray Follador for a full day of fossil and geology activities. For the last 15 years, Matt has brought a class of 70 students for science and art activities in the Carnegie Museum of Natural History and Carnegie Museum of Art respectively.

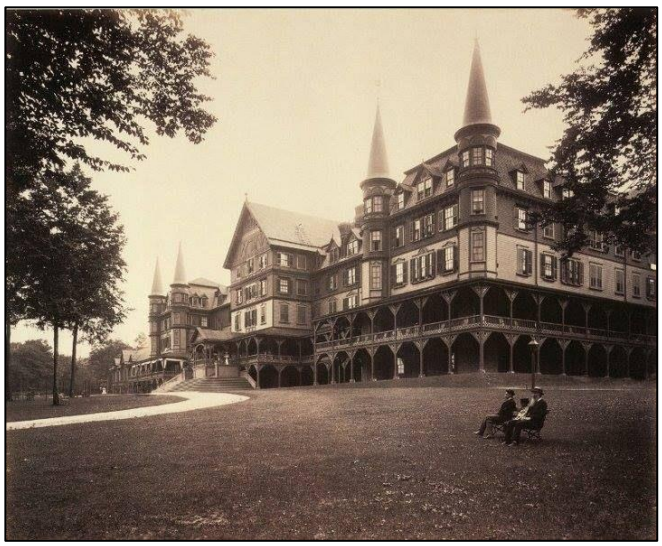
The hands-on activities in the Section of Invertebrate Paleontology include building fossil kits from the section's general collections, breaking fossil rock that the students get to keep, and learning about different groups of fossils large and small, including the trilobite *Phacops rana*, the State Fossil of Pennsylvania.

THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES

Ignatius Adams, a Revolutionary War veteran, was granted a tract of land at the summit of Allegheny Mountain along the Huntingdon, Cambria and Indiana Turnpike (which later became known as US Route 22). This route was the first major link between Philadelphia and Pittsburgh. Jacob Troxel, one of the first settlers to the area, established the Laurel Swamp Inn, later called Troxel's Tavern, about a mile west of the summit.

In 1830, Dr. Robert Jackson acquired the tavern and began promoting the healthful effects of mountain air and soon a small town sprang up that attracted industry and catered to wealthy businessmen and their families. He named the community Cresson in honor of his friend, John Elliot Cresson. Local springs were found to have medicinal value, so the area first became a resort town, promoted as a place for recreation and convalescence.

Cresson later became a hub of commerce when the Pennsylvania Railroad (PRR) established its headquarters there. In 1881, the PRR opened the Mountainhouse Hotel as a way to attract Pittsburghers to the greater Johnstown area. Although initially successful, people eventually began to flock to the seashore instead and the hotel was torn down in 1916.



The majestic Mountainhouse hotel in Cresson, Pennsylvania as it looked in its heyday.

DID YOU KNOW . . . ?

Sedimentary rocks more than 2.4 ga sometimes have unusual sulfur isotope compositions that commonly are thought to have been caused by the action of UV light on volcanically-produced SO_2 in an O_2-poor atmosphere. But a team of geochemists from Penn State and the University of Maryland showed an alternative origin that might point to an early, O_2-rich atmosphere. This is significant because it suggests that abnormal isotope fractionations of sulfur might not be linked to the atmosphere after all. This means that the strongest evidence for a 2.4 billion-year-old O_2-poor atmosphere has been brought into question.

Artist's conception of an early Earth. Determining the conditions that were present on the early Earth is essential to understand how life originated and continued to evolve through time.

The researchers presented, instead, the possibility that rocks with an anomalous sulfur isotope fractionation came from locations on the ocean floor where hydrothermal fluids seeped up from submarine vents through organic carbon-rich sediments and mixed with ocean water. Sulfur has four naturally occurring isotopes, none of which are radioactive. Although 95% of sulfur has an atomic weight of 32, the other 5% is composed of sulfur having atomic weights of 33, 34, or 36. While the relationships among the amounts of S^{33}, S^{34}, and S^{36} typically are predictable based on the differences in their atomic weights, in the early rocks examined the relationships are often anomalous.

The researchers focused on looking at samples of amino acids and sodium sulfur compounds to try to recreate the anomalous sulfur isotope composition in another way. The amino acids acted in the experiments as a proxy for organic material because the anomalous sulfur isotopes often come from black shales that contains abundant mature kerogen compounds; the sodium compounds were used because of the large amounts of sodium and sulfate in the ocean. The researchers used different amino acids and sodium compounds in 32 series of experiments with more than 100 individual samples before finding that alanine and glycine mixed with sodium sulfate produced the anomalous isotope composition found in the rocks.

Since this study significantly shifted the possibilities for anomalous sulfur isotope fractionation in the early Earth to a biological and thermal regime, there are now at least two ways that the anomalous sulfur isotope fractionation seen in some rocks could have been achieved. Although sulfate-reducing bacteria do not produce anomalous isotope relationships, the remains of simple organisms, coupled with thermal sulfate reduction, does produce the anomalous isotope signature. The researchers next planned to look at dead cyanobacteria ("blue green algae") to see if their organic material will fuel the thermal reaction to produce anomalous sulfur isotope relationships.

https://www.astrobio.net/earth/sedimentary-rocks-speak-of-sulfur/

Engineers from MIT, working with scientists in Kuwait, found that volcanic ash can act as a sustainable additive to replace Portland cement in concrete structures. The researchers reported that this can reduce the total energy that goes into making concrete for a given structure. For example, it requires 16% less energy to construct 26 concrete buildings made with 50% volcanic ash with an average particle size of 17 µm as compared with the energy it takes to make the same structures entirely of traditional Portland cement. A mixture of volcanic rock, finely-ground to a powder, and Portland cement produced stronger concrete structures compared with those made from traditional cement.

The process of grinding volcanic ash down to very fine particles requires energy, however, which increases the energy needed to make the resulting structure, resulting in a trade-off. Experimenting with various concrete and volcanic

ash mixtures resulted in the researchers mapping out the relationship between strength and energy. This relationship can be used as a blueprint to help choose the percentage of Portland cement that can be replaced by volcanic ash to produce a given structure. Thus, a traffic block would not need as much strength as a high-rise building, so the former could be produced with much less energy. Considering that concrete is the second most abundantly-used material in the world (water is first), this could be huge.

One of several volcanos occurring in the area of Al-Aayiss near the Saudi city of Madina.

In order to manufacture normal concrete, you first have to blast or dig limestone out of a quarry, transport it to one or more crushers, and then heat it through various processes in kilns to produce Portland cement. This requires a large amount of energy; it also accounts for about 5% of the world's CO_2 emissions. Then the cement has to be mixed with sand and gravel to make concrete, and each of these additives requires its own production and transportation energy use, as well as creating its own CO_2 footprint.

The MIT researchers were looking for sustainable additives and alternatives to cement in order to cut down on the CO_2 emissions. Volcanic ash has advantages as an additive in manufacturing concrete: 1) it occurs in ample supplies around both active and inactive volcanoes around the world; 2) it typically is considered to be a waste material; and 3) some volcanic ashes have natural properties that, in powder form with a reduced amount of cement, will bind naturally with water and other materials to form cement-like pastes.

While Portland cement production takes a lot of energy because of the high temperatures involved, volcanic ash forms under high heat and high pressure, so Mother Nature already took care of the necessary chemical reactions. During the team's calculation, they found that a city's infrastructure can be made with considerably less energy if the buildings are built with concrete made from a cement mixture that is 30% volcanic ash. In further research, they used synchrotron X-Ray diffraction and other techniques to examine the microstructure of hardened cement pastes. They found that finer-sized volcanic ash particles produced nanometer-scale products within the cement paste as it hardened, which helped to densify the matrix as it cured. This work provides a basis for engineers to optimize their mixes with natural additives according to their specified requirements.

http://news.mit.edu/2018/cities-future-built-locally-available-volcanic-ash-0206

Steven Jasinski, a University of Pennsylvania paleontologist, recently discovered a new species of fossil turtle named *Trachemys haugrudi* that lived at the Miocene-Pliocene boundary at the Gray Fossil Site in eastern Tennessee, an ancient sinkhole that was surrounded by a forest. Among the animals previously found there were a red panda, a Eurasian badger, a kinosternid turtle, and a colubrid snake. The 5.5-ma *Trachemys haugrudi* was related to the extant red-eared slider *Trachemys scripta elegans*. It was a small turtle, not more than 10 inches in total shell length.

Artist's concept of *Trachemys haugrudi*.

Fossil turtles, like extant ones, are best known from their shells, although the fossil shells typically are found in broken pieces, so gaps or holes remain. Sometimes only single small pieces are found, so that the whole animal has to be inferred from other information, including other fossil and

living species. Despite this, fossils of *Trachemys haugrudi* provided dozens of shells, several of which were nearly complete.

This study sought to determine where *Trachemys haugrudi* was positioned in the evolution of similar turtles both within the genus and in related genera. Jasinski determined that the Gray Fossil Site turtle was most closely related to a group of fossil turtles from Florida, and next most closely related to a group of fossils from the Midwest, so that as an assemblage they were a closely related group situated within the still-living species of *Trachemys* such as those that live in Mexico, Central and South America, and the Caribbean region.
Species from the United States, including the red-eared slider turtle, are found near the base of this 'branch' of the *Trachemys* family tree - their fossil ancestors are still waiting to be discovered – whereas the fossil *Trachemys* species in Jasinski's study are on a distinct part of the *Trachemys* tree. Current understanding of the fossil and living species suggests that the former did not give rise to the latter, implying that *Trachemys* diversity in the past was far greater than exists today. Extant *Trachemys* turtle species are considered "plastic", implying that they can adapt to living in many environments; such an adaptive lifestyle may be a relatively newer characteristic of these turtles. Lack of such a lifestyle in the fossil populations might explain the difference in diversity; i.e., there were a lot of species in the past, each occupying a separate environment, whereas living *Trachemys* can adapt to many different environments, so there are fewer species.

http://www.sci-news.com/paleontology/new-fossil-turtle-species-tennessee-05765.html

Humans have been gazing at the after effects of the shower of electrons bouncing across Earth's magnetosphere, commonly called the Aurora Borealis or Northern Lights, at least since modern humans evolved some 300 ka ago. The spectacle is legendary as green, red, and purple swaths of light dance across the night sky, blending into one another for a fantastic show widely considered one of the great wonders of the world. But while the cause of these colorful lights has long been hypothesized, researchers had never directly observed the underlying mechanism until recently.

Now, for the first time, an international team of researchers from Japan, Taiwan, and California has seen it because of a new satellite launched by the Japan Aerospace Exploration Agency that has advanced measuring tools. Called the Exploration of energization and Radiation in Geospace (ERG) satellite (also known as the Arase spacecraft), the satellite allowed researchers to see that the aurora is caused by difficult-to-detect interactions between electrons and plasma waves that take place in the Earth's magnetosphere.

Auroral substorms, as they have been termed, are caused by global reconfiguration in the magnetosphere, which releases stored solar wind energy. They are characterized by auroral brightening from dusk to midnight, followed by violent motions of distinct auroral arcs that eventually break up and emerge as diffuse, pulsating auroral patches at dawn. The global reconfiguration often drives a specific type of plasma waves called chorus waves, to rain electrons into the upper atmosphere. This stabilizes the system and gives off a colorful light as the electrons fall.

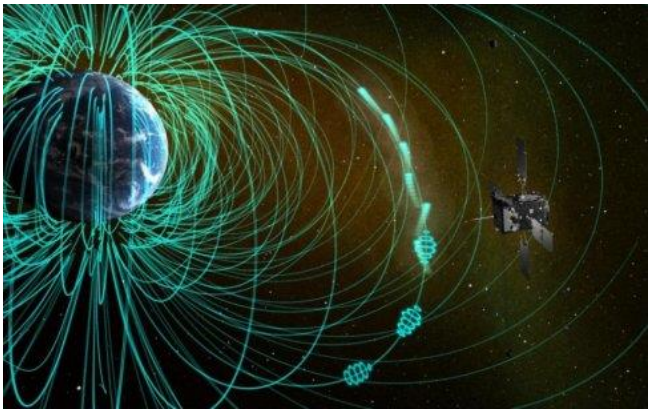


Illustration of the ERG spacecraft observing chorus waves and scattered electrons in the magnetosphere, the origin of pulsation auroras

Scientists had questioned if the chorus waves were powerful enough to excite electrons to the extent of creating auroras, but the recent satellite data allowed the researchers to observe directly the scattering of electrons by chorus waves generating particle precipitation into the Earth's atmosphere. The precipitating electron flux was sufficiently intense to generate pulsating aurora. Scientists couldn't see this direct evidence of electron scattering previously because typical electron sensors cannot distinguish the precipitating electrons from others.

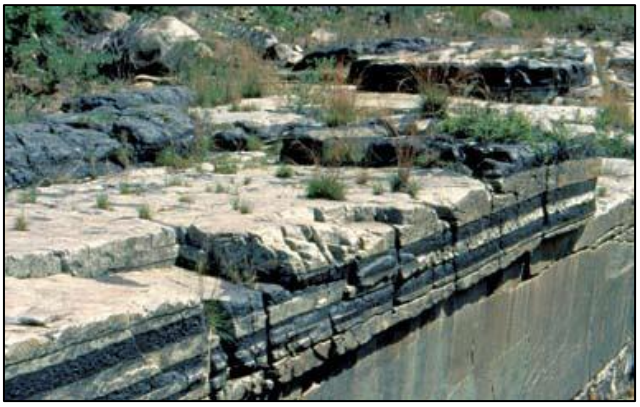
The international team designed a specialized electron sensor that observed the precise interactions of auroral electrons driven by chorus waves. By analyzing data collected by the ERG spacecraft more comprehensively, the team hope to reveal the variability and further details of plasma physics and resulting atmospheric phenomena, such as auroras, in future studies.

https://www.sciencedaily.com/releases/2018/02/180214150052.htm

The history and economy of South Africa were built on its rich natural resources of precious metals, gems, and minerals, and its mineral deposits were created over hundreds of millions of years through processes that are still not completely understood. One of those troubling processes is the origin of chromitite layers hosted by layered intrusions, one of the major sources of chromium (and platinum) on Earth.

Chromium is an important industrial element that substantially improves the physical and chemical properties of steel, increasing its strength and making it corrosion-resistant. Platinum associated with chromitite is used in catalytic converters in cars to break down toxic exhaust gases into relatively benign gases. The process of forming layers of pure chromium that are coming from Earth's mantle in magma layers that should be rich in olivine, rather than chromite, was a mystery for decades. Geologists tried finding a mechanism that could explain the formation of such large chromite deposits in shallow crustal chambers. It turned out they had been looking in the wrong place.

To find the answer a team of researchers based in South Africa studied layers of chromite in South Africa's famous Bushveld Complex, where over 80% of the global resources of platinum-bearing chromite deposits are found. They discovered that some basaltic magmas will form chromite after decompression as they rise up from the mantle through the crust towards the Earth's surface. The reduction in pressure as the magma rises is key to the crystallization process of the chromite. When the magma is emplaced in a shallow magma chamber only a few miles below the surface of the Earth, it is already saturated in pure chromite, so when the magma cools it can crystallize layers of platinum-bearing massive chromitite. The zebra-striped layers of platinum-bearing chromite that are formed through this process can be seen clearly in the ridges at the top of the Bushveld Complex, near Steelpoort in Mpumalanga. This outcrop became exposed through erosion over the many millions of years. Some of the layers are several meters thick and extend for hundreds of miles.



Tiger-striped chromitite deposits in the Bushveld Igneous Complex of South Africa.

The researchers think that the Bushveld chamber must have been operating as a flow-through system into which magmas were entering and depositing their chromite, before flowing out of the chamber and erupting as basalt volcanoes that have since been eroded away. The reduction of lithostatic pressure during the transfer of mantle-derived melts towards the surface probably played a vital role in the formation of magmas that produced such natural resources across the globe. Additional research is now being conducted on whether other magmatic deposits, such as vanadium-bearing magnetite in layered intrusions, can also be related to lithostatic pressure reductions.

https://www.sciencedaily.com/releases/2018/03/180301103627.htm

During the Early Cretaceous, around 90 ma, eastern and western North America was split in half for about 30 million years by an inland sea that separated Appalachia in the east from Laramidia in the west. At that time, the ancestors of those iconic dinosaurs, *Triceratops* and *Tyrannosaurus*, roamed Laramidia in what today are Utah and Alberta, and their fossils are fairly abundant. But the lack of fossils from eastern North America historically has concealed Appalachia, leading to it being called a “lost landmass”.

New research, however, is expanding our knowledge of the dinosaurs that once lived and died in the eastern United States and Canada. Dinosaurs from this area have always been regarded as rather strange by scientists. For example, one relative of *Tyrannosaurus rex* from New Jersey has gigantic hands with giant claws, much different from the tiny arms of its Laramidia cousin. Thirty-five-foot-long duck-billed dinosaurs such as the world-famous *Hadrosaurus foulkii*, discovered and excavated in 1858, left their remains in parts of North Carolina and New Jersey (*Hadrosaurus foulkii* is the official state dinosaur of New Jersey).

***Hadrosaurus foulkii* Leidy from Haddonfield, NJ, the first "nearly complete" Appalachian dinosaur ever found, on display at the Academy of Natural Sciences of Philadelphia.**

So far, all of the named eastern North American dinosaurs are known only from incomplete skeletons – eastern North American dinosaur fossils typically include only a stray bone shard or tooth, unlike the famous fossil deposits of the American West, hindering attempts at better understanding the distribution and evolution of dinosaurs during the Cretaceous.

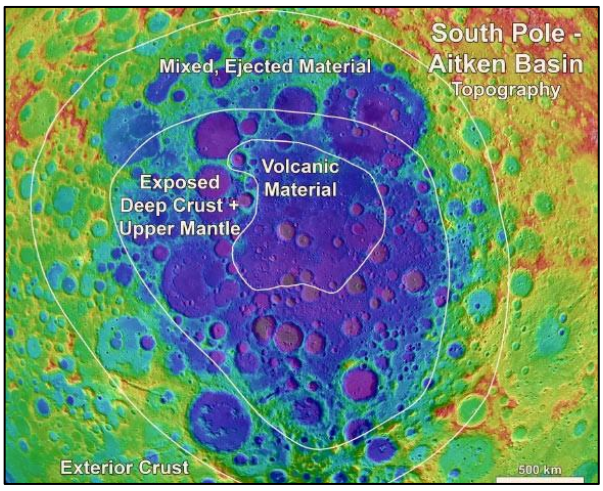
Recently, a paleontologist in Stamford, Connecticut, investigated this issue by tallying up reports of dinosaurs from across the eastern part of North America from publications spanning over 150 years of scientific inquiry. He compared the compiled list of Appalachian dinosaurs both to each other and to those from the American West to understand how two faunas changed from each other during their separation. His results suggest that eastern North American dinosaur faunas were distinct from those of the west, and that Appalachian forms were more “primitive” than their Laramidian relatives. The new research also might show that the dinosaur wildlife differed in different parts of Appalachia, a phenomenon known as faunal provincialism.

http://www.sci-news.com/paleontology/dinosaurs-lost-landmass-appalachia-05747.html

A team of planetary scientists from Brown University and the Goddard Space Flight Center has mapped the mineralogy of the South Pole-Aitken (SPA) basin, a very large impact structure on the far side of the Moon. The result is a highly detailed look at the compositional structure of the basin using modern, cutting-edge data. SPA has long been regarded as a target for future lunar landers, so the team hopes their work will serve as a framework for more detailed study and landing site selection.

SPA measures approximately 1,550 miles in diameter and is thought to be the oldest and largest impact basin on the Moon. The large impact that created may have blasted all the way through the Moon’s crust and into the mantle. A visit to SPA to grab a sample of that exposed mantle material could provide critical clues about the Moon’s origin and evolution. A sample could also help scientists put a firm date on the impact.

To get the proper samples, however, it is important to know the where the best locations are to find them. So the researchers used detailed data from the Moon Mineralogy Mapper, a spectrometer that flew aboard India’s Chandrayaan-1 spacecraft, to identify four distinct mineralogical regions that form a bullseye pattern within and around the basin.



The SPA crater’s four distinct compositional regions within and around the basin.

At the center of the bullseye is a region of what appears to be deposits of volcanic material, suggesting that the center of the basin may have been covered by a volcanic flow sometime soon after the impact. The central region is surrounded by a ring of material dominated by Mg-rich pyroxene, which is thought to be plentiful in the lunar mantle. Outside of that is a ring in which pyroxene mixes with the standard crustal rocks of the lunar highlands, and farther outside is the basin exterior where the signatures of impact-related material disappear.

Although the middle of a crater typically has the deepest excavation, the data suggest, among other things, that it might be difficult to find pristine mantle material there because of the large volcanic deposit. Therefore, it would be wiser to land in the ring surrounding the center in order find the best place for concentrated mantle material.

On the other hand, a spot that has both mantle material and volcanics might be an ideal landing site because the volcanics are interesting in their own right. Their composition appears to be somewhat different from that of other volcanic rocks found on the Moon, suggesting that they might have a unique origin, perhaps related to the extreme geophysical environment that would have been in place during the formation of the basin.

Therefore, a good spot to land might be near the border of the volcanic center and the pyroxene ring. The scientists also found several craters in the volcanic patch where the pyroxene material might have been re-excavated, so those areas could also be targets for going after both mantle material and volcanics.

http://www.sci-news.com/space/south-pole-aitken-basin-mineralogy-05773.html

A team of paleontologists recently analyzed numerous footprints of adult, juvenile, and infant Columbian mammoths found in a layer of volcanic soil at the Pleistocene Fossil Lake locality in central Oregon (Fossil Lake is a site that was first excavated in 1876 and is administered today by the Bureau of Land Management). Their research suggests that *Mammuthus columbi* may have moved like modern elephants with infants in matriarchal groups.

The researchers found 117 mammoth tracks, including one adult trail, partial trackways of three additional adults, a yearling, and a baby, all heading generally west. The tracks were mapped and documented using photogrammetry, which helped them perform accurate measurements based on land-based or aerial photographs.

Footprints of 43,000-year-old Columbian mammoths in a Pleistocene dry lake bed, Oregon.

Tracks sometimes tell more about ancient creatures than their bones, particularly when it comes to their behavior. The researchers zeroed in on a 20-footprint track, dating to roughly 43 ka, that showed some intriguing features. The prints were especially close together, with those on the right more deeply impressed than those on the left, as if an adult mammoth had been limping. In addition, two sets of smaller (juvenile) footprints appeared to be approaching and retreating from the “limping” trackway.

This suggests that the juveniles may have been interacting with an injured adult female, returning to her repeatedly throughout the journey, possibly out of concern for her slow movements, such as has been observed with wounded adults in modern, matriarchal herds of African elephants. The researchers were amazed to see this kind of interaction preserved in the fossil record.

http://www.sci-news.com/paleontology/columbian-mammoths-trackway-05723.html

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Fun Fact Having Nothing to Do with Geology

The average American will spend an average of six months during his or her lifetime waiting at red lights.

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