



# PITTSBURGH GEOLOGICAL SOCIETY

May 11, 2022

## MEETING TIMES

Social Hour 5:30 PM  
Dinner 6:30 PM  
Speaker 7:30 PM

## DINNER COSTS

\$35.00 regular member  
\$15.00 student member  
\$40.00 non-member

## RESERVATIONS

Email your name and  
number of attendees to:

[pgsreservations  
@gmail.com](mailto:pgsreservations@gmail.com)

Or reserve and use PayPal:

[https://www.pittsburgh  
geologicalsociety.org/](https://www.pittsburghgeologicalsociety.org/)

## MEETING LOCATION

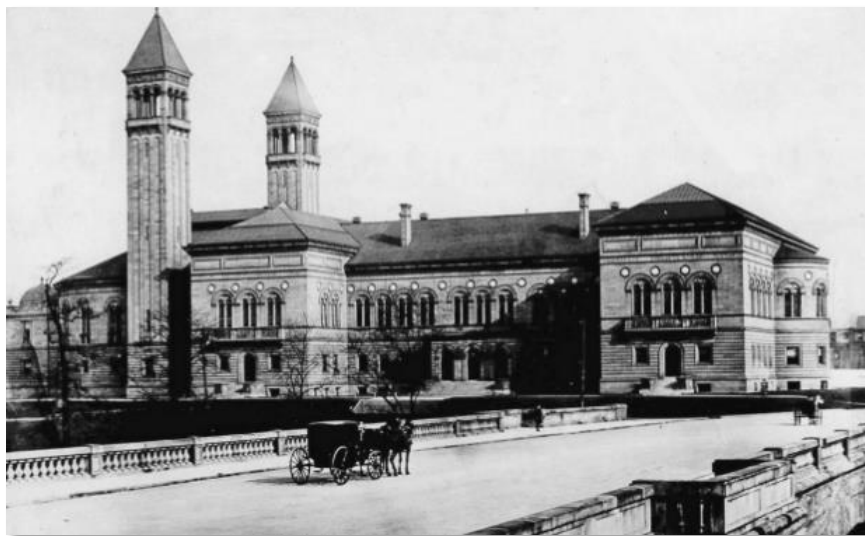
**NEW - PENN BREWERY**

## COVID19 POLICY

See page 3 for current guidance.

## The Gilded Age of Oakland

The Beaux-Arts Architectural Style that  
Built the Carnegie Library of Pittsburgh,  
Carnegie Institute Extension, and Carnegie  
Institute of Technology (CMU) Campus



**Albert Kollar**  
Carnegie Museum of Pittsburgh

**NOTE – THIS MEETING WILL BE HELD AT  
PENN BREWERY ON THE NORTH SIDE**

**Please RSVP by Wednesday, May 4**

## Speaker Abstract

By the turn of the 20th century, the Beaux-Arts architectural style dominates the Gilded Age cultural and academic buildings in the Pittsburgh suburb of Oakland. Andrew Carnegie the steel industrialist turned philanthropist, started the building boom with the Carnegie Library of Pittsburgh in 1895, Carnegie Institute of Technology in 1905, and the Carnegie Institute Extension in 1907. Other Beaux-Arts buildings include the Phipps Conservancy (1893), Schenley Hotel (1897), and the Soldiers and Sailors Memorial Hall (1908). Carnegie recommended moving what was then known as the University of Western Pennsylvania from downtown Pittsburgh to Oakland, which was where it was renamed in 1908 as the University of Pittsburgh. In 1913, Andrew and Richard B. Mellon founded the Mellon Institute of Industrial Research of the University of Pittsburgh that merged with Carnegie Tech to form Carnegie Mellon University in 1967. Geology plays a significant role in the building of these structures both in the exterior and interior with exceptional building stones from antiquity. The 300-million-year-old bedrock of Oakland was eventually eroded by rivers and streams during the Pleistocene Epoch to form relatively flat landscapes for streets and land, enabling the creation of the remarkable buildings we see today along Forbes and Fifth Avenues. In the early 1880's, Carnegie, while standing above what was Schenley Farms, envisioned a library as the portal entrance to a green space now called Schenley Park.



## Speaker Biography

Albert Kollar is the Head of Section and Collections Manager for the Section of Invertebrate Paleontology at the Carnegie Museum of Natural History. He is a three-time past PGS President and current Board member who has received both the Eastern Section AAPG George V. Cohee Public Service Award (2017) and the GSA GSIS Award for Best Guidebook (co-authored with fellow PGS member John Harper) for “Geology of the Early Iron Industry in Fayette County, Pennsylvania” (2018).

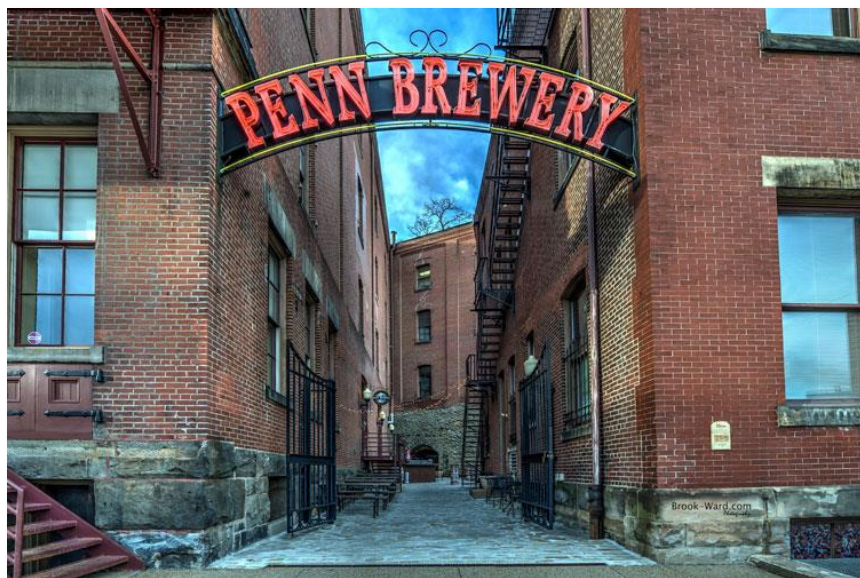


Albert's interest in art and architecture is well known. He has been particularly interested in the paintings of one of Pittsburgh's most celebrated artists, John Kane (1860-1934), who immortalized many Pittsburgh neighborhoods; Kane's work became the focus of some of Albert's field trips. Albert has also studied many of the landscape paintings of the 19th and 20th centuries at the Carnegie Museum of Art to provide a historical perspective to the progressive changes in climate recorded in them. In addition, his passion for architecture and the history of building stones, particularly those of the Gilded Age in the Pittsburgh region, has provided museum docents and visitors alike with a deeper understanding and appreciation of the geology that went into building the Carnegie Museum of Natural History, the Carnegie Library, Carnegie Institute of Technology (now Carnegie Mellon University) and many other local, regional, and national buildings.

Please note that PGS is monitoring the COVID-19 situation closely and will continue to modify policy based on the recommendation of national and local experts. We ask that our members please consult and follow the US Centers for Disease Control and Prevention (CDC) recommendations for Allegheny County as shown here:

<https://www.cdc.gov/coronavirus/2019-ncov/your-health/covid-by-county.html>

## Note - PGS is Using a New Venue for our May Meeting



**Penn Brewery -  
Northside - [Main  
Location](#)**

**800 Vinial Street,  
Pittsburgh PA**

## Mark Your Calendars for Next Year's PGS Speaker Series!

Program Chair Pete Hutchinson has already lined up a dynamic set of speakers for next year. Put these dates in your calendars to make sure you don't miss any of these upcoming meetings.

Meeting Date	Speaker	Presentation Topic
September 21, 2022	John Harper	Of Ice and Waters Flowing: The Geologic History of Pittsburgh's Three Rivers
October 19, 2022	Scott Burns	The Terroir of Wine
November 16, 2022	Richard Smosna and Kathy Bruner	Prehistoric cave art of Northern Spain
December 14, 2022	Craig Eckert	Geology of the Appalachian Trail
January 19, 2023	TBA	Joint AEG-ASCE Meeting
February 15, 2023	TBA	TBA
March 15, 2023	Peter Dodson	Collecting Dinosaurs on Four Continents
April 19, 2023	TBA	Student Night
May 10, 2023	TBA	TBA

# PRESIDENT'S STATEMENT

Though our spring has thus far been damp and chilly, I'm hopeful that the rain will provide beautiful flowers and productive gardens along with the recent transition to warmer and drier temperatures. The outdoors are calling and I'm sure we are all ready for a little sunshine.

Our April meeting was a blast and PGS offers a heartfelt thank you to all of our student presenters who put their research on display. I always enjoy seeing what our up-and-coming scientists are up to and appreciate the time that goes into preparation of posters and talks.

Also in the April meeting were a couple of exciting announcements including an advertisement for the upcoming joint southeastern and northeastern sectional meeting for the GSA to be held in Reston, VA from March 17-19, 2023. Proposals for technical sessions, field trips, and short courses are currently eligible for submission so if any of our members would like to contribute, please seek further information at the meeting website at [geosociety.org](http://geosociety.org).

In addition, please remember that elections for the PGS board will be happening soon so watch for election announcements and please remember to vote. It also bears mentioning that all members are eligible to serve on one of our many committees and are encouraged to do so. Get involved!



Our final meeting for the program year will take place a week earlier than our usual schedule on the second Wednesday of May, on the 11th. This meeting will also take place at a different venue: Penn Brewery on Vinial Street on Pittsburgh's North Side. Directions may be found on the PGS website.

Unfortunately, our original speaker, James McDonald had to cancel, but our backup speaker will be our very own Albert Kollar! I also won't be in attendance, unfortunately, and I'm bummed about missing this talk because it sounds amazing. Though I won't see you this time, I do hope to see you next year when we reconvene for our 2022-2023 program year. I hope it's as exciting as this one was.

See you in the fall and have a great summer!

*Dan*

***A note from Election Committee Chair Ray Follador:***

**The annual PGS election is approaching on May 11<sup>th</sup>. We strongly urge all professional members to cast their ballot. Ballots will be sent separately of the newsletter in the near future with return mailing directions provided.**

# LOCAL GEOLOGICAL EVENTS

## SOCIETY OF PETROLEUM ENGINEERS (SPE)

**May 5, 2022**

**12:00 PM – 1:30 PM**

“Virtual Training Session - Linking Soft Skills to Career Development” by Ron Morgan, PhD, Chief Technical Advisor-Cementing, Halliburton Energy Services, Inc.

Details: <https://connect.spe.org/pittsburgh/events/eventdescription?CalendarEventKey=3c70c09d-cddc-4064-abc1-f73d77ce0d43>

Free registration: [https://docs.google.com/forms/d/e/1FAIpQLScj8bY4mMEd3dFntJOsG-GraBkwMtsXe6\\_h293pnIcqXfaiJg/viewform](https://docs.google.com/forms/d/e/1FAIpQLScj8bY4mMEd3dFntJOsG-GraBkwMtsXe6_h293pnIcqXfaiJg/viewform)

## SOCIETY OF WOMEN ENVIRONMENTAL PROFESSIONALS (SWEP)

**May 12, 2022**

**12:00 PM – 1:00 PM**

“Virtual Brown Bag Lunch Event Featuring the PA DEP”

Details and registration: <https://swep3rivers.org/event-4808250>

## GEOPHYSICAL SOCIETY OF PITTSBURGH (GSP)

**June 15, 2022**

**8:00 AM – 3:30 PM**

“3<sup>rd</sup> Annual Appalachian Basin Geophysical Symposium. Keynote Address: “Adapting conventional reservoir methods for unconventional purposes – Examples from the Marcellus and other unconventional basins” by Dr. Brian Russell, GeoSoftware LLC

Details and registration: <http://www.thegsp.org/event-4659047>

Hilton Garden Inn/Southpointe, Canonsburg, PA

## PENNSYLVANIA COUNCIL OF PROFESSIONAL GEOLOGISTS (PCPG)

**June 22, 2022**

**1:00 PM - 2:00 PM**

“In-situ Remediation of Sulfate Contamination” by Alex Krichevsky, PhD, MBA, Phoenix Environmental Research (Webinar: 60 minutes)

Details and registration: <https://pcpg.org/event-4671266>

# 2022 PGS STUDENT FIELD WORKSHOP

This year's student drilling workshop on April 8 and 9 not only introduced budding geologists from across the region to what it is like to work on an actual field sampling site, it also gained some media attention for California University of Pennsylvania as well as for PGS. Click here to read the nice write-up that our drilling workshop received from the Observer-Reporter newspaper:

[https://observer-reporter.com/news/localnews/california-university-to-host-geology-workshop/article\\_e21e9df2-b5cf-11ec-bec0-6fe130906244.html](https://observer-reporter.com/news/localnews/california-university-to-host-geology-workshop/article_e21e9df2-b5cf-11ec-bec0-6fe130906244.html)



# WINNERS OF THE PGS SCIENCE FAIR AWARDS

The Carnegie Science Center's Pittsburgh Regional Science and Engineering Fair was held March 22-23 at the Carnegie Science Center on the North Shore. The PGS Sponsor Judges were Steve Frank, Michael Bikerman, and Wendell Barner. PGS sponsors two awards, one for the Intermediate (Middle School) Division and one for the Senior Division. The award winners and their abstract are provided below.

## Intermediate Award Winner

**Naviah Andree**, Mary Queen Apostle School, Science Teacher Cheryl Kestner

### **MEE110: How pH Affects Clam Shells?**

Clams are an important part of our ecosystem. They rotate nutrients, filter feed: which purifies water, and trap carbon from the atmosphere. Clam shells are made of calcium carbonate, the clam makes a shell through its mantle, or the tissue that bonds to the inside of the clam's shell. The mantle uses minerals and proteins to create the shell. pH levels can have a great effect on clam shells. As ocean waters steadily become more acidic the shells can become slimmer or smaller in size making the clams more vulnerable. Problem Statement- The purpose of this project is to determine the effect of various pH levels on clam shells. Methodology- The clams were massed before tests were done and separated into groups of 30 for each of the 7 pH ranges. The clams were then allowed to sit in the solutions for 7 days and taken out, allowed to air dry for 24 hours before being massed. This procedure was repeated for 6 weeks. Results - Results were averaged and then the percent change was calculated. The average mass of the clam shells increased as the pH levels increased, beginning with a pH of 6 and culminating with a pH of 9. While those in the pH of 4 and 5 declined. Surprisingly, the shells in a pH of 5 lost almost twice as much mass as those in the lower pH of 4. A T-test was run to determine the confidence level of my results being able to be replicated. A confidence level less than 95% would be classified as non-significant. This means that the outcome of the test was by chance and cannot be replicated. This is shown in the results for a pH of 5. A confidence level of 99.9%, means that the results of my test can be replicated. This applied to the pH of 4, 7, 8 and 9, while a pH of 6 shows a confidence level of 99.99% which also means that these results can be replicated. Implications- Knowing how pH levels affect the clams can make us more aware of how the pH of the ocean water is changing due to ocean acidification and allow us the opportunity to do something to prevent the loss of this precious resource.

## Senior Division Winner

**Hadley Hellgren**, Freeport Middle School, Science Teacher Kayla Uveges

### **SEE125: The Effect of Hydraulic Fracking on Earthquake Frequency Across the United States Midwest**

Significant earthquakes have occurred without tectonic plate boundary activity or other known explanations. The purpose of this experiment is to determine the effect of hydraulic fracking on earthquake frequency. It is hypothesized that counties with higher amounts of fracking wells and related violations will have higher frequency of earthquakes compared to counties with less or no fracking wells. Using the USGS.org earthquake database, earthquakes above 0.5 magnitude were recorded in various counties with large amounts of fracking wells and counties with small amounts of fracking wells across the midwest United States region. The number of fracking wells and violations in a county were recorded using fractracker.org. Using statistical analysis, the data was compared and analyzed for correlations and trends. Final results will be available at the fair.

# LOCAL EVENTS OF INTEREST TO PGS MEMBERS

## ASSET MANAGEMENT



TRANSPORTATION  
& DEVELOPMENT  
INSTITUTE



UTILITY ENGINEERING  
& SURVEYING  
INSTITUTE

Pittsburgh  
Chapter

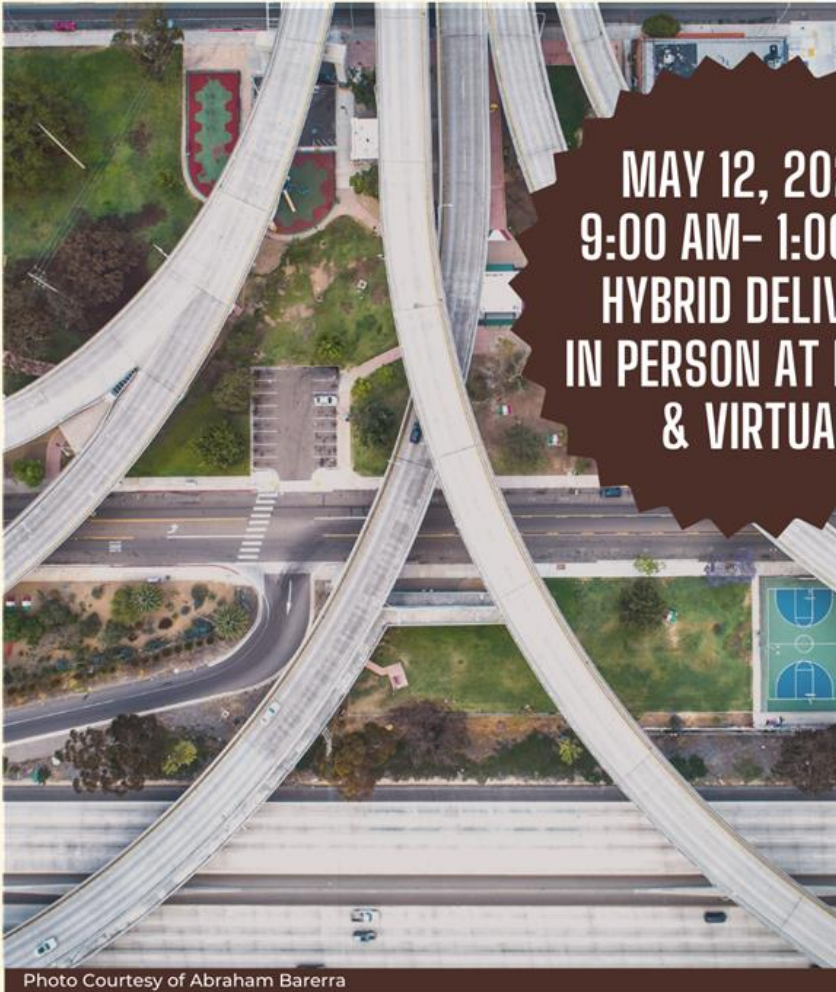


Photo Courtesy of Abraham Barerra

**MAY 12, 2022  
9:00 AM- 1:00 PM  
HYBRID DELIVERY  
IN PERSON AT ESWP  
& VIRTUAL**

**GAIN  
INSIGHT  
AND  
LEARN  
FROM  
CASE  
STUDIES**

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### IN-PERSON\*

ASCE Members/Government: \$60

Affiliate Members: \$60

Non-Members: \$100

Students: \$25

\*includes Continental Breakfast  
& Lunch

### ONLINE

Members/Govt/Affiliate:

\$20 per session (\$50 for all three)

Non-Member:

\$30/session (\$75 for all three)



# LOCAL EVENTS OF INTEREST TO PGS MEMBERS



## Eastern Section AAPG Monthly Tech Talk – Lunch and Learn May 25<sup>th</sup>, 2022, 1 pm (Eastern Time)

*Grab your lunch, huddle around the computer, and enjoy an ES-AAPG Technical Talk*

## Unleashing US LNG, The Greatest Green Initiative On The Planet

Toby Z. Rice, President and CEO,  
EQT Corporation

Toby Z. Rice was named EQT's President and Chief Executive Officer in July 2019, when he also was elected to the company's Board of Directors. Since May 2018, Toby has served as a Partner at Rice Investment Group, a multi-strategy fund investing in all verticals of the oil and gas sector. From October 2013 until its acquisition by EQT in November 2017, Toby was President, Chief Operating Officer and a member of the Board of Directors of Rice Energy. Previously, he served in several positions with Rice Energy, its affiliates and predecessor entities – beginning in February 2007 – including President and Chief Executive Officer of a predecessor entity from February 2008 through September 2013.



Register in advance for this webinar:

[https://us06web.zoom.us/webinar/register/WN\\_9\\_KNEV6vR4qrN4sNyHaoUA](https://us06web.zoom.us/webinar/register/WN_9_KNEV6vR4qrN4sNyHaoUA)

# THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES

Sometime around 1727, a Native American settlement arose in the valley between Chestnut Ridge and Laurel Mountain, near the confluence of Mill Creek and Loyalhanna Creek. It was still a relatively new village when the first colonial traders arrived in 1732. Then in 1758, during what became known as the French and Indian War, General John Forbes decided to build a series of forts between what are now Bedford and Pittsburgh to establish British dominance over the French. One of the forts, built near the Native American village, was named for the commander-in-chief of the British Army, Field Marshall Lord John Ligonier.



**Reconstruction of Fort Ligonier, a restored French and Indian War fort and site of the battle that basically turned the war in favor of the British Army. Artillery batteries, cannons, wagons, and buildings were all rebuilt on the original site of the fort.**

After an attack by the French and their Native American allies in which this alliance was severely beaten, Forbes' army moved on to the Forks of the Ohio and the French retreated north to Canada. Ligonier has since been called "the Key to the West in 1758" because the victory there was the turning point for the British. Colonel John Ramsey laid out a town in 1817 when the new Philadelphia-Pittsburgh Turnpike (now US 30) was constructed across the valley. Ligonier grew slowly and finally was incorporated as a borough in 1834. After that, it began to thrive as the crossroads of the valley and the local farmers' "shopping center." Today, Historic Ligonier, and the Ligonier Valley, are home to Fort Ligonier, Linn Run State Park, Story Book Forest, Idlewild Park, and the Compass Inn.

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## DID YOU KNOW . . . ?

As any Pennsylvania insurance company will tell you, landslides are an "act of nature," and as such you and your property are generally uninsurable against them (other than some companies that will sell you a landslide insurance policy at an exorbitant price!). They tend to cost lots of money to repair. Unfortunately for western Pennsylvanians, more and more landslides keep popping up, including in the City of Pittsburgh. How many are the city monitoring? Is the list growing faster than in past years?

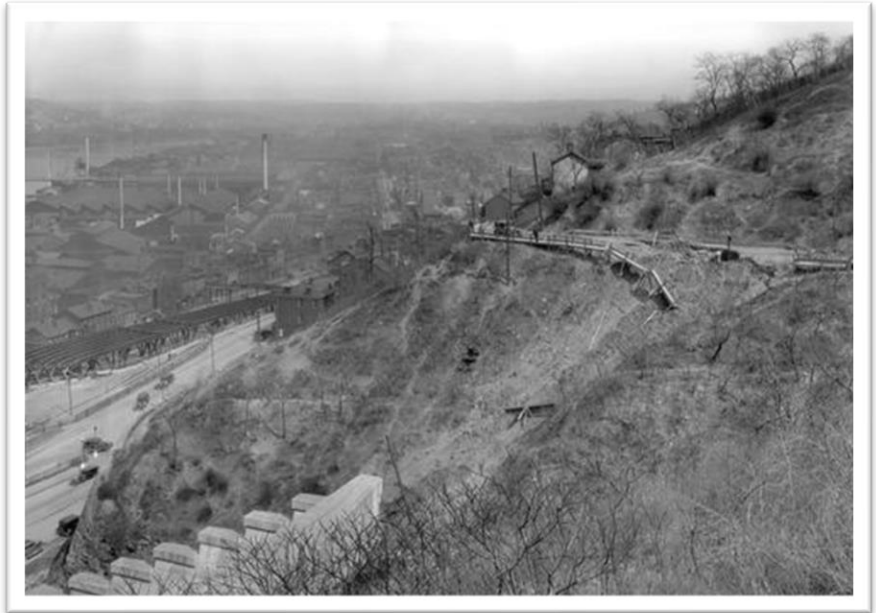
There is a landslide on Drycove Street in the Bon Air section of Pittsburgh adjacent to Beltzhoover that is causing people to be afraid the city will condemn their homes as their legal bills pile up. Jersey barriers have been placed on Andover

Terrace in North Oakland because the street is shifting and pulling away from the sidewalk. One of the more concerning landslides occurred on El Paso Street in the Morningside neighborhood in February, 2022 – concerning because its appearance has deteriorated since first being reported. Morningside residents have been expressing their anxieties. One resident said the slide stopped at the bottom of his deck and the deck tipped over. Others are alarmed because the mail and delivery vehicles keep struggling to maneuver along the street, which has been narrowing as the land continues to move. The city's lead engineer, Eric Setzler, indicated that this slide is next in line for repairs.

State Representative Emily Kinkead, who represents the Bellevue/West View area, has proposed funding to help homeowners stuck with high bills to repair landslides on their properties in the hopes of creating a way to help affected homeowners because homeowners insurance does not cover the cost. What she has found out, as those of us who have been involved in landslide identification and remediation have known for years, is there is nothing the state and city can or will do to help people recover their property and losses unless the landslide occurs on state or city property. Whoever owns the land that moves is responsible for fixing the landslide.

So, as hard as it is for the city to find the resources to fix the landslides it's responsible for, imagine what would be in store for the typical homeowner. Pittsburgh is tracking about 120 slides right now, but monitoring only about 75 because not all require immediate action. The city is spending about \$5 million annually to research, complete designs, and fix landslides, but that isn't nearly enough. There are also sidewalks, stairs, and bridges to fix, as motorists who used the Fern Hollow Bridge on Forbes Avenue in Frick Park are well aware.

<https://pittsburgh.cbslocal.com/2022/04/04/pittsburgh-active-landslides/>



**Historic photo of a 1933 landslide on Williams Street on the South Side Slopes above West Carson Street and the South Side. The northern portal of the Liberty Tunnels is in the lower left corner. Landslides like this cause millions of dollars in damage every year with little or no regard for local homeowners.**

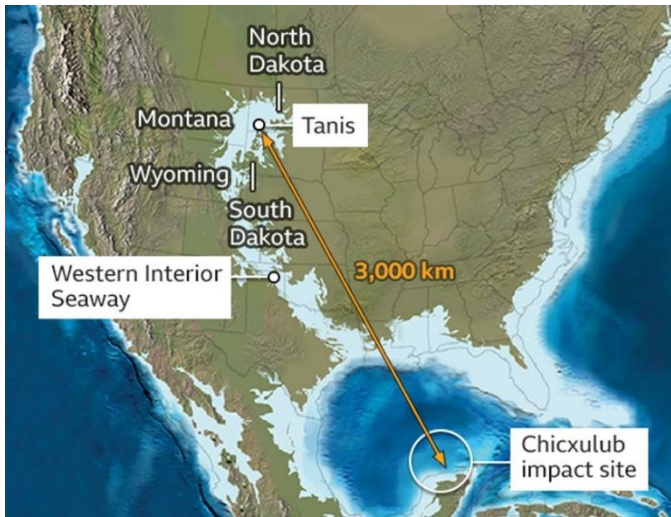
inside its egg; and what appears to be a fragment from the asteroid itself.

If true, this is an amazing find. Very few dinosaur remains have been found even close to the time of the impact. To have a specimen from the catastrophe itself would be astonishing. Although the impact site that has been identified off the Yucatan Peninsula is about 1865 miles away from North Dakota, the impactor released so much energy that its devastation was felt far and wide. There are so many details at the site that explain what happened moment by moment that it has been described as almost like watching it play out in the movies. The remains of animals and plants, as well as sediment, seem to have been dumped by enormous waves of river water set in motion by enormous earthquakes. Aquatic and terrestrial organisms are all mixed together.

Sturgeon and paddlefish at the site have small particles stuck in their gills, identified as glass spherules of molten rock from the impact that were blown into the atmosphere only to fall back across the face of Earth. The fish must have breathed in the spherules as they entered the river. These spherules have been linked by both chemistry and radiometric dating to the Chicxulub impact. Two of the particles recovered from preserved tree resin also include inclusions believed to be of extra-terrestrial origin.

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A paleontology graduate student from the University of Manchester in the UK who has been working at a site in Tanis, North Dakota, may have discovered what he and his team believe to be evidence of the day the dinosaurs died when a giant asteroid struck the Yucatan Peninsula, the infamous Chicxulub impact, 66 ma ago. The evidence includes: a stunningly preserved leg of a dinosaur, complete with skin; a fossil turtle that was skewered by a wooden stake; the remains of small mammals and the burrows they made; skin from a *Triceratops*; the embryo of a pterosaur



**Purported evidence of the day the dinosaurs died comes from a site in Tanis, North Dakota.**

But the big question is whether all of these creatures actually died on the day the asteroid struck as a direct result of cataclysm. The team thinks so, but not everyone is convinced. At least one expert says it's possible, for example, that the animals had already died before the impact, then were unearthed by the violence on the day and reburied in a way that made their deaths appear concurrent. Although the fish with the spherules in their gills appear to be solid evidence of the asteroid impact, some of the other claims appear to be based on circumstantial evidence that hasn't yet been presented to the world to be thoroughly examined. The Tanis discoveries, first announced in 2019, attracted the BBC, who have been filming and interviewing for three years. Sir David Attenborough will host a program scheduled for broadcast on BBC One on April 15, with a version that will be broadcast in the US on PBS's Nova series later this year.

<https://www.bbc.com/news/science-environment-61013740>

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And speaking of the dinosaur-killing asteroid impact at Chicxulub, a team of scientists now think that sulfur from that event caused considerably more global cooling than previously thought. A new study finds that when the asteroid collided with Earth 66 ma ago, massive amounts of sulfur were thrown into the stratosphere where, once airborne, a vast cloud of sulfur-bearing gases

blocked the sun and cooled Earth for decades to centuries before falling back to Earth as lethal acid rain. That would have changed the chemistry of the oceans for tens of thousands of years, longer than previously thought. The fact that sulfur would have continued pouring down on Earth's surface for so long could help explain why it took so long for life, especially marine life, to recover.

The team's finding was completely serendipitous. They originally had planned to study the geochemistry of fossil shells near the Brazos River in Texas, which was under water during the end-Cretaceous extinction. The researchers took a few samples of sediment from the site to the University of St. Andrews, Scotland, where a team member analyzed the different sulfur isotopes and found a very unusual signal – unexpected tiny changes to their masses. Such mass changes occur when sulfur enters the atmosphere and interacts with UV light, which can only happen either in an atmosphere lacking oxygen or when the sulfur has traveled really high up into an oxygenated atmosphere.



**Artist's rendering of *T. rex* chicks shivering in the cold following the asteroid impact at Chicxulub 66 million years ago. According to new research, the impact caused sulfur aerosols to enter the atmosphere, which led to a long period of global cooling.**

Although volcanoes spew sulfur into the atmosphere that eventually fall back to Earth, large sulfur volumes typically do not occur in marine rocks because the sea has its own isotopic signature that dilutes sulfur from volcanic activity. The fact that this signal is present in Cretaceous marine rocks indicates that there must have been a lot of sulfur in the atmosphere after the impact event. That, of course, has huge implications for climate change related to the impact.

Much of the sulfur came from sulfur-rich limestones of the Yucatan Peninsula. If the asteroid had hit somewhere else, there probably wouldn't have been as much sulfur released into the atmosphere. The climate change that followed might not have been as severe and the extinction event might not have been so dramatic. Previous estimates of sulfur aerosols entering Earth's atmosphere after the asteroid impact ranged from about 30 to 500 gigatons; according to climate models, the sulfur would have turned into sulfate aerosols, which would have caused 3.6 to 14.4°F cooling of the Earth's surface for a few decades after the impact. The new findings, however, suggest that, because the amount of sulfur in the atmosphere was higher, climate change could have been far more severe.

<https://www.livescience.com/sulfur-dinosaur-killing-asteroid-impact>



A new study reports that helium-3 ( $^3\text{He}$ ), a rare isotope of helium, has been leaking out of Earth's core. Although some natural terrestrial processes can generate  $^3\text{He}$ , such as the radioactive decay of tritium ( $^3\text{H}$ ), almost all of it was created during the Big Bang because helium is one of the earliest elements produced in the universe. But  $^3\text{He}$  is also made in nebulae, and the new study provides evidence that Earth formed inside a solar nebula, an idea that has long been debated.

As a planet like Earth grew, it accumulated material from its surroundings; its composition reflects the environment in which it formed.  $^3\text{He}$  has been measured at Earth's surface in relatively small quantities, but scientists had no idea how much of it was leaking from the Earth's core versus how much was leaking from the mantle.

This new study identifies the core as a major source of  $^3\text{He}$  on the Earth. Approximately 2,000 grams of  $^3\text{He}$  leak out of the Earth's interior annually, enough to fill a balloon the size of a desk.

Yet there's still a significant amount of it in Earth's interior. And in order to get large concentrations of  $^3\text{He}$  deep in the core, Earth would have had to form inside a prospering solar nebula, not on its periphery, nor during its waning phase.

The researchers modeled helium during two key stages of Earth's history – early formation (when the planet was accumulating helium) and following the formation of the Moon, after which helium was lost. There is evidence suggesting that an object roughly 1/3 the size of the Earth hit the planet around 4 ga ago, which would have re-melted the Earth's crust and allowed much of the helium to escape. It continues to escape to this day.

Using the modern  $^3\text{He}$  leak rate, along with models of helium isotope behavior, the researchers estimated there are between  $10^{13}$  and  $10^{15}$  grams of  $^3\text{He}$  in the core. This is a huge amount that the researchers say points to Earth's formation inside the solar nebula, where high concentrations of the gas would have allowed it to build up deep in the planet. Future work looking for other nebula-



**A Hubble Telescope image of the center of Lagoon Nebula. Nebulae are the primary sources of helium-3 ( $^3\text{He}$ ) since the Big Bang, and the amount of  $^3\text{He}$  leaking from the Earth's core suggests the planet formed inside a solar nebula.**

created gases like hydrogen that are leaking in similar rates and locations as  $^3\text{He}$  might be a "smoking gun" for the core as the source they said. As with most science, there are a lot more mysteries than certainties.

<https://scitechdaily.com/new-clues-to-earths-formation-from-ancient-helium-leaking-from-the-planets-core/>



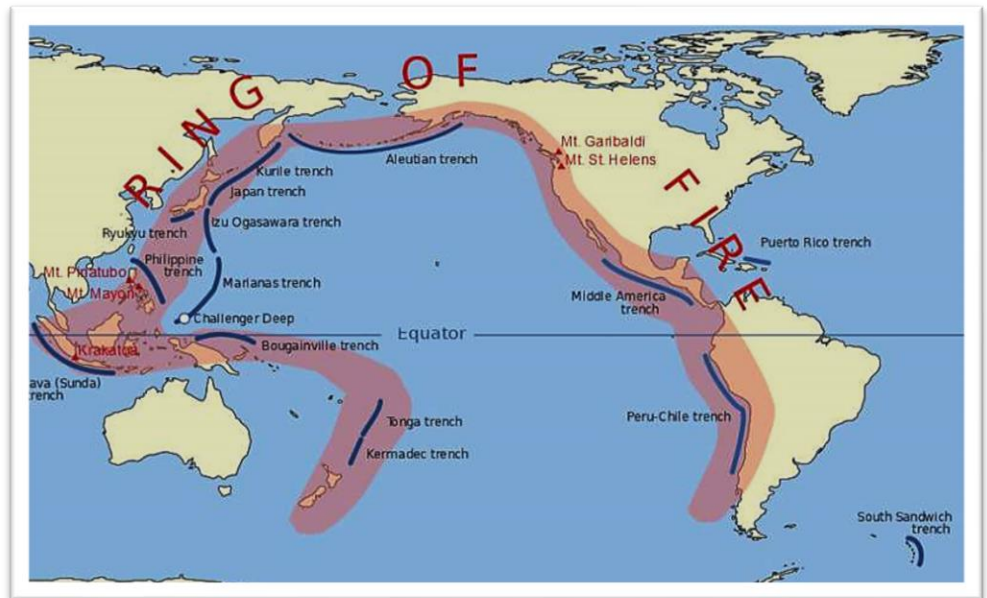
A research team from Portugal and Germany recently developed an advanced numerical model of one of the main processes behind the movement of Earth's tectonic plates. These plates are like jigsaw puzzle pieces that are in constant, but very slow motion, averaging less than about 4 inches annually. The puzzle pieces don't quite fit together, however, as some plates end up in subduction zones when they plunge beneath another plate. This is all central to the dynamics of the planet.

Although all of this movement is very slow in human terms, it can lead to moments of great energy release and the formation of large mountain ranges and marine trenches.

Geologists already knew that the subduction zone process, on a time scale of thousands of years, can languish and reverse itself, giving rise to new subduction zones, but the exact way in which this happened was not clear. Now, for the first time, a three dimensional simulation has been created for one of the most common processes of formation of new subduction zones, ensuring that all forces are dynamically and realistically modeled, including Earth's gravity.

Subduction zones are the main driver of plate tectonics and the global dynamics of the planet. They are also the places where earthquakes of great magnitude occur, as is the case of the Pacific Ring of Fire, the largest system of subduction zones in the world. It was extremely important to understand how new subduction zones begin and how this process takes place. Each of the simulations that led to the new results took up to a week to process on a supercomputer. It could have taken weeks, or even months, to run on the supercomputer had it not been for a recently developed computational code that was significantly more efficient than other available codes.

It had already been theoretically proposed that new subduction zones were more likely to form from pre-existing ones, but models like this new one had never been carried out. It shows that the formation



**The Pacific “Ring of Fire,” showing the locations of major subduction zones.**

of new subduction zones seems to be easier and more likely to occur than had been anticipated. The new model opens up a new range of perspectives and represents a starting point for studying specific regions of Earth. The researchers are now applying their models to specific cases, such as subduction zones in the Atlantic Ocean, the Caribbean, the Scotia Arc, next to Antarctica, and on the Southwest Portuguese margin. The latter could lead to the closing of the Atlantic Ocean. The researchers suggest the 1755 Lisbon earthquake could have been the harbinger of the beginning of subduction on the Portuguese margin, and say there are marine geology data that support that possibility.

<https://phys.org/news/2022-03-fundamental-movement-earth-tectonic-plates.html>

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Researchers, using a combination of satellite and atmospheric modeling, have seen short-term, regional fluctuations in anthropogenic atmospheric CO<sub>2</sub> globally for the first time. The new study used data from NASA's Orbiting Carbon Observatory-2 (OCO-2) to measure drops in CO<sub>2</sub> emissions during the COVID-19 pandemic from space. Daily and monthly data products now available to the public open new possibilities for tracking the collective effects of human activities on CO<sub>2</sub> concentrations in near real-time.



**NASA's OCO-2 measures the amount of CO<sub>2</sub> in the atmosphere over areas like Las Vegas to help researchers better characterize the sources and sinks of greenhouse gases.**

Previous studies that investigated the effects of lockdowns early in the pandemic found that global CO<sub>2</sub> levels dropped slightly in 2020. By combining OCO-2's high-resolution data with modeling and data analysis tools from NASA's Goddard Earth Observing System (GEOS), however, the new study was able to narrow down which monthly changes were the result of human activity and which resulted from natural causes at a regional scale, thus confirming previous data estimates based on economic and human activity.

The team's measurements showed that in the Northern Hemisphere, human-generated growth in CO<sub>2</sub> concentrations dropped from February through May 2020 and then rebounded during the summer. These data are consistent with a global emissions decrease of 3-13% for the year. The measurements weren't as clear in the Southern Hemisphere because of the Indian Ocean Dipole (IOD), a cyclical pattern of cooler-than-normal oceans in Southeast Asia and warmer-than-normal oceans in the eastern Indian Ocean.

In late 2019 and early 2020, the IOD experienced an intense phase that yielded a plentiful harvest season in sub-Saharan Africa and contributed to the record-setting Australian fire season. Both events strongly affected the carbon cycle and made detecting the signal of COVID lockdowns difficult, but also demonstrated GEOS/OCO-2's potential for tracking natural CO<sub>2</sub> fluctuations in the future. Researchers studying regional effects of

climate change, and tracking results of mitigation strategies, are now ahead of the game because this new method allows detection of changes in atmospheric CO<sub>2</sub> only a month or two after they happen. This will provide rapid information about how both human and natural emissions such as plant respiration and exchanges with the world's oceans evolve.

When we ended up staying home early in the pandemic, there were fewer cars on the road, which meant there were

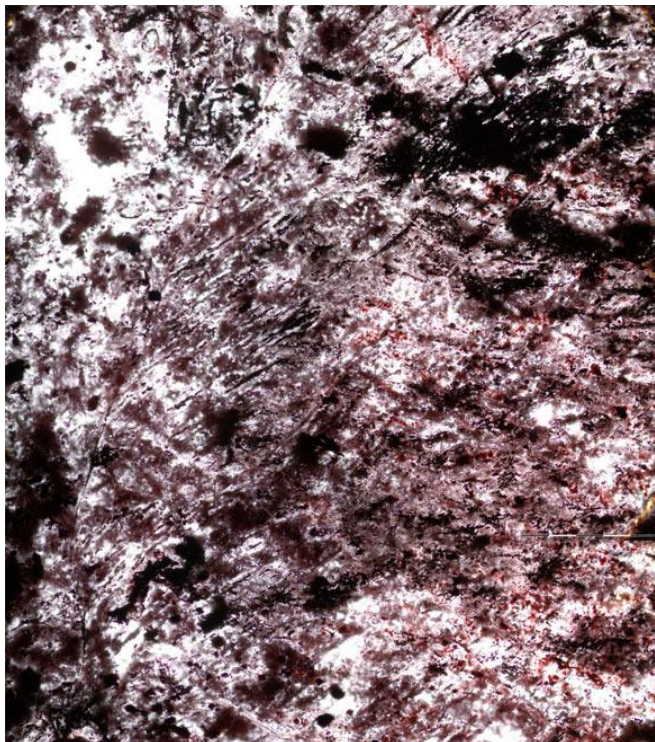
steep drops in the amount of greenhouse gases and pollutants released into the atmosphere. But CO<sub>2</sub> can remain in the atmosphere for as much as a century after it is released, so that short-term changes can get lost in the overall global carbon cycle. Early in 2020, the researchers saw fires in Australia that released CO<sub>2</sub>, additional uptake from plants in India, and other aspects all mixed up, challenging them to try to disentangle the disparate data in order to understand what all the different components were. Measuring these kinds of changes wasn't possible with satellite technology until recently.

Now, combining NASA's OCO-2 satellite with its high-precision spectrometers designed to pick up even smaller fluctuations in CO<sub>2</sub>, combined with the comprehensive GEOS Earth system model, the researchers were able to spot the pandemic-related changes. By comparing measured changes in atmospheric CO<sub>2</sub> with independent estimates of emissions changes due to lockdowns, they found strong evidence that the reductions were due to human activities. The GEOS-OCO-2 assimilated product is available for free download, making it accessible to researchers and students who want to investigate further.

<https://scitechdaily.com/nasa-makes-first-of-its-kind-detection-of-reduced-human-co2-emissions/>

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As previously reported, paleontologists found 3.75- to 4.28 ga old microscopic filaments and tubes in rocks from the Nuvvuagittuq Supracrustal Belt in Québec, Canada several years ago that seemed to have been made by iron-loving bacteria. There were some scientists, however, who disputed that these structures were of biological origin since they were about 300 ma older than what had been accepted as the first sign of life on Earth.



**Photomicrograph via transmitted light of bundles of branching hematite filaments and co-occurring clusters of ellipsoids from the Nuvvuagittuq Supracrustal Belt in Canada that suggests life on Earth began far earlier than originally thought.**

Now, after further study of the Nuvvuagittuq rocks, the paleontologists discovered a larger and more complex structure consisting of a nearly 1 cm long stem with parallel branches on one side and hundreds of ellipsoids alongside the tubes and filaments. The scientists argue that although it is possible that some of the structures might have been created through chance chemical reactions, the branching stem most likely is biological in origin because nothing like it is known to have been created by chemistry alone.

This means that a form of microbial life might have existed on Earth as little as 300 ma after the planet formed. Geologically speaking, that would have been really quick. The Nuvvuagittuq Supracrustal Belt, which contains some of the oldest sedimentary rocks known on Earth, originated on the seafloor, possibly near a system of hydrothermal vents.

After collecting the rocks, the researchers made thin sections (100  $\mu\text{m}$  thick) to study the tiny fossil-like structures, which are made of hematite and encased in quartz. Because the thin sections were more than twice as thick as earlier sections the researchers had cut, the team was able to see larger hematite structures in them, and to compare the structures and their compositions to more recent fossils and to modern iron-oxidizing bacteria located near hydrothermal vent systems today.

They found modern-day equivalents of the twisting filaments, parallel branching structures, and ellipsoids near an undersea Hawaiian volcano, as well as at vent systems in the Arctic and Indian oceans. They used micro-CT and ion beam techniques to show the hematite filaments were wavy and twisted and contained organic carbon. These are all characteristics shared with modern-day iron-eating microbes. The team concluded that the hematite structures could not have been created through metamorphism. Even the levels of rare earth elements in the fossil-laden rock occurred at the same levels as in other ancient rock specimens, confirming that the seafloor deposits were as old as the surrounding volcanic rocks.

Their discovery implies that it takes only a few hundred ma for life to evolve to an organized level on a primordial habitable planet, which has broader implications for the possibility of extraterrestrial life. Microbial ecosystems could exist on other planetary surfaces where liquid water interacted with volcanic rocks, suggesting that extraterrestrial life may be more widespread than previously thought. Given the right conditions, if life is relatively quick to emerge, this increases the chance that life exists on other planets.

<http://www.sci-news.com/paleontology/nuvuagittuq-fossils-10712.html>



# WEBSITE OF THE MONTH

<https://directory.eoportal.org/web/eoportal/satellite-missions/o/oco-2>



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### ***Fun Fact Having Nothing to Do with Geology***

You can get a rough estimate of the outdoor temperature in degrees F by counting the number of cricket chirps in 14 seconds and adding 40.

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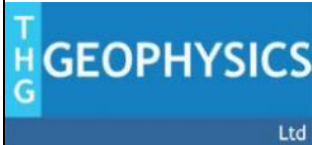


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