# PITTSBURGH GEOLOGICAL SOCIETY

**September 18, 2019**

**NEW MEETING TIMES**

| | |
|---|---|
| **Social Hour** | **5:30 PM** |
| **Dinner** | **6:30 PM** |
| **Speaker** | **7:30 PM** |

**NEW DINNER COSTS**

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

**For Reservations**

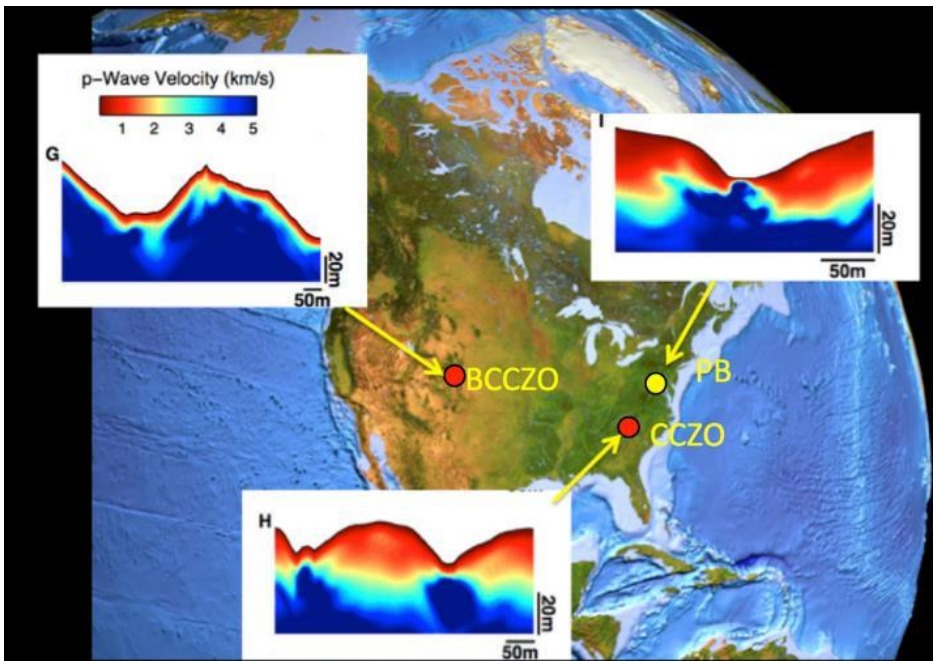
Email your name and number of attendees to: pgsreservations@gmail.com

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

**Meeting Location**

Cefalo's Banquet & Event Center, Carnegie PA

## Fractures, Weathering and Water: A Geophysical View of Critical Zone Structure in the Appalachians and to the West




## Dr. W. Steven Holbrook

**Professor of Geology & Department Head**
**Department of Geosciences, Virginia Tech**

**Make Reservations by Wednesday, September 11**

# Speaker Abstract

The “critical zone (CZ),” Earth’s near-surface layer that reaches from treetop to bedrock, sustains terrestrial life by creating porosity, storing water, producing soil, and releasing nutrients. Despite its central importance to life on Earth, however, the CZ remains poorly understood, due in part to the complexity of interacting biogeochemical and physical processes that take place there, and in part to the difficulty of measuring CZ properties and processes at depth. Major outstanding questions include: What is the architecture of the CZ? How does that architecture vary across scales and across gradients in climate, lithology, topography, biology and regional states of stress? What processes control the architecture of the CZ? At what depth does weathering initiate, and what controls the rates at which it proceeds?

Based on recent geophysical campaigns at seven Critical Zone Observatory (CZO) sites and several other locations, a geophysical perspective on CZ architecture and processes is emerging. CZ architecture can be usefully divided into four layers, each of which has distinct geophysical properties: soil, saprolite, weathered bedrock and protolith. The distribution of those layers across landscapes varies depending on protolith composition and internal structure, topography, climate (P/T) and the regional state of stress. Combined observations from deep CZ drilling, geophysics and geochemistry demonstrate that chemical weathering initiates deep in the CZ, in concert with mechanical weathering (fracturing), as chemical weathering appears concentrated along fractures in borehole walls. I will present a geophysical perspective on critical zone structure and evolution based on those observations, and point the way to future progress in better understanding Earth’s critical zone.

# Speaker Biography

Dr. W. Steven Holbrook was born and raised in eastern Pennsylvania, near Reading. He attended Penn State University, where he received a B.S. in geoscience with an emphasis in geophysics. Following a year in the oil industry at Chevron, he returned to grad school, completing M.S. and Ph.D. degrees in geophysics at Stanford University. He spent nearly a decade as a scientist at Woods Hole Oceanographic Institution and two decades as a professor at the University of Wyoming before returning to Appalachia, joining the Department of Geosciences at Virginia Tech as department head in 2017.

For most of his career, Dr. Holbrook has been a marine geophysicist, studying methane hydrates, physical oceanography, and the deep structure of continental margins, during which he has accumulated a year and half at sea. For the past decade his work has focused on applying near-surface geophysics to understanding the distribution of water and porosity in the subsurface of upland watersheds (Earth’s “critical zone”).

# PRESIDENT'S STATEMENT

It is a new program year, and with a new year comes new beginnings, new hours and new costs. The social hour will begin at 5:30 (cash bar and snacks available), dinner at 6:30 (buffet style) and the program at 7:30. For the past several years, PGS has tried to keep the price of dinner relatively reasonable but costs at our venue have increased and therefore we have had to respond by increasing our prices. This year, dinner at the monthly meetings is $35 for regular members, $15 for student members, and $40 for non-members. The price for membership has also increased for regular members from $25 to $30.

The program is set for this year (see page 5) and it looks like we are in store for a good season with a variety of interesting topics that span across the disciplines of geology. It is our hopes that our diverse program will pique the interest of many new and returning members to attend the monthly meetings. If you have not been to a meeting in a while, consider joining us at our newest venue, Cefalo's in Carnegie. The renovated 127-year-old stone structure of the former Christ United Presbyterian Church is now a banquet and events center. If you have never been to Cefalo's, come and check it out.

I want to express my sincere gratitude to all the board members for their continued commitment to PGS. Thank you for your years of volunteer service and the time and effort involved in running a professional society. PGS would not exist without your commitment. I would like to welcome the new, recently elected board members, past Director-at-Large, Diane Miller (Secretary), and previous officer/board members, Michael Bikerman (Director-at-Large) and Michael Keeliher (Director-at-Large).

I would like to express my sincere gratitude to Karen Rose Cercone for keeping our website updated and producing, along with John Harper, our monthly newsletter. I would also like to thank Kenneth LaSota, who has completed his two-year term as Secretary. It is one of the more time-consuming positions and we appreciate his willingness to serve PGS in this manner. I also want to thank outgoing Directors-at-Large Mary Ann Gross and Erica Love. I am sure that Mary Ann and Erica will not be strangers and will continue to remain active even though they are not board members. Mary Ann is a co-leader for the PGS Fall field trip on September 7 and Erica will continue assisting with her media duties. Lastly, I would like to thank Jacob Podrasky, Student Representative to the Board of Directors from CALU. Jacob has graduated and is off doing wonderful things.

2020 will be a big year for PGS. We will be celebrating our 75th anniversary! We are beginning to plan for the big event and will keep you updated as we continue our discussions. Please let us know if you have any ideas on how we should celebrate this momentous event. If you have any ideas that you would like to share with the board, send along an email to me or anyone of the board members or submit a comment through the website.

I would like to remind you to renew your membership early so you can take advantage of all the benefits. As you are renewing your membership, please consider donating an extra dollar or two to the Galey Fund to help support the student meals at our monthly meetings. Each student member pays a discounted rate and PGS covers the rest.

I am looking forward to working with the board this year and the members of PGS. See you at the meetings.

*Tamra*

## LOCAL GEOLOGICAL EVENTS

### GEOPHYSICAL SOCIETY OF PITTSBURGH

**September 10, 2019 5:00 PM-7:30 PM**

"Tank Development in the Midland Basin, Texas: A case study of super-charging a reservoir to optimize production and increase horizontal well densities" by Dr. Jon McKenna, Geological Engineer, FracRx

**Cefalo's Banquet & Event Center, Carnegie PA**

### PA COUNCIL OF PROFESSIONAL GEOLOGISTS

**September 12, 2019 5:00 PM-6:30 PM**

Join PCPG for conversation and complimentary beer/wine/soda on Thursday, September 12. Please register to let PCPG know who's coming

**Doubletree by Hilton Pittsburgh, Cranberry PA**

### SOCIETY OF PETROLEUM ENGINEERS

**September 17, 2019 11:00 AM-1:00 PM**

"Fiber Optics; Technology Advances and Deployment Solutions" by Jay Hewitt, Hewitt Energy Strategies LLC

**Cefalo's Banquet & Event Center, Carnegie PA**

### AMERICAN SOCIETY OF CIVIL ENGINEERS – GEO-INSTITUTE KICK-OFF DINNER MEETING

**September 26, 2019 6:00 PM-9:00 PM**

"SR 30 Emergency Landslide Repair, A Geotechnical Perspective" by Brian Heinzl, Gannet Fleming, Inc.

**Engineers' Society of Western Pennsylvania**


**The Pittsburgh Geological Society welcomes the following new members:**

Emily V. Glick, PG
Geologist IV, TetraTech

Ian B. Lynch
Hydrologic Technician, U.S. Geological Survey

Jason M. Lee
Geoscientist, Sci-Tek Consultants, Inc.

**Plus a recent university graduate member:**

Anthony J. Gentilcore
2019 BS, Clarion University of Pennsylvania

**We also welcome new student member:**

Jacob G. McCloskey
Allegheny College

## THE PITTSBURGH GEOLOGICAL SOCIETY ENDOWMENT FUND

*Established May 8th, 2014 through the*

COMMUNITY FOUNDATION
*Serving the Heart of Western Pennsylvania*

# UPCOMING PGS MONTHLY MEETINGS


The next PGS Dinner Meeting will be held on October 16, 2019.

**Dr. Yurena Yanes**

**LAND SNAILS AS PALEOCLIMATE PROXIES: FROM LOCAL TO GLOBAL SCALES**

Fenneman Assistant Research Professor
Department of Geology
University of Cincinnati

| ***Meeting Date*** | ***Scheduled Speaker*** | ***Presentation Topic*** |
|---|---|---|
| November 13, 2019 | Christopher Russoniello,<br>West Virginia University | Hydrogeology |
| December 18, 2019 | Pat Burkhart,<br>Slippery Rock University | Machu Picchu |
| January 15, 2020 | TBA,<br>Joint Meeting with ASCE and AEG | Engineering Geology |
| February 19, 2020 | George Davis,<br>University of Arizona | Structure/Tectonics |
| March 18, 2020 | Kendra Murray,<br>Hamilton College | Geomorphology |
| April 15, 2020 | Student Research Night<br>Joint Meeting with ASCE and AEG | Student Posters & Presentations |
| May 13, 2020 | Randy Blood,<br>DRB Geological Consulting | Energy Resources |

# PGS FIELD TRIP GUIDEBOOK ON GEOLOGY OF EARLY IRON INDUSTRY WINS NATIONAL AWARD!

We are very proud to share with our members a recent email we received from the Geoscience Information Society, an affiliate of the Geological Society of America:


August 26, 2019

Dear Dr. Harper and Dr. Kollar,

It is my pleasure to inform you that the Geoscience Information Society's Guidebooks Committee has selected the *Geology of the Early Iron Industry in Fayette County* to receive the 2019 Best Guidebook Award (professional category). The award will be presented at the GSIS Awards luncheon during the Geological Society of America annual meeting in Phoenix, AZ on September 23, 2019. The GSIS typically provides lunch for the authors or their designated representative. Let me know if anyone will be there to accept the award in person. The committee commends you on this enticing blend of history and geology in an open access format. Congratulations on receiving this award!

Sincerely,
Linda Musser, Guidebooks Committee co-chair

For many years, both John Harper and Albert Kollar have been stalwart supporters of the PGS mission to educate the public and local geoscientists about geology in general and our region's rocks, landscapes, and fossils in particular. Their presentations and publications include numerous field guides, museum pamphlets, and much of the content in this very newsletter. We cannot think of two geologists more deserving of this honor.

## Congratulations to You Both!

# THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES

Between 1803 and 1837, former U.S. Senator James Ross acquired 2,150 acres along the Allegheny River and extending about 1.5 miles inland. This eventually became part of O'Hara Township owned by Ross's descendants, primarily the Delafields and Aspinwalls. It was generally quiet countryside, about seven miles upriver from the smoky, smelly, industrialized city that was 19th century Pittsburgh.

**The Sauer House on Center Avenue in Aspinwall was designed and built in 1898 by architect Frederick C. Sauer (1860–1942). It is part of the Sauer Buildings Historic District, which was added to the National Register of Historic Places on September 11, 1985.**

Henry Warner, superintendent of the Allegheny County Workhouse, thought about acquiring some land to build a residential community along the bank of the river, and he set his sights on the old Ross property. Warner traveled to New York to discuss the idea, and eventually bought 155 acres of land from Annie Aspinwall, the primary landowner. The Aspinwall Land Company was formed in 1890, and offered Pittsburghers 60 available home sites to purchase. The new town proved to be popular and soon had 400 residents, mostly young couples with children.

In 1892, when O'Hara Township developed difficulties providing services to the rapidly growing area, 40 residents of the new community petitioned for incorporation as a borough and on December 28 the Borough of Aspinwall became officially incorporated. In 1904, some borough residents, including famed architect Frederick C. Sauer, bought 200 acres from the Delafield Company and formed the Aspinwall-Delafield Company. They started development in 1905 at the eastern end of Aspinwall and by the end of the summer, the streets had been paved, sewers had been installed, and annexation of this section to the borough was completed. Arguably, Aspinwall's most famous resident, Frederick Sauer was born in Germany, but moved to the Pittsburgh area and built a house on Center Avenue. It is considered the first dwelling built in what would later become the Sauer Buildings Historic District, a collection of buildings he designed, built, and worked on during his lifetime.

*For more information on the Sauer Buildings Historic District, you can visit the following websites:*

https://www.livingplaces.com/PA/Allegheny_County/Aspinwall_Borough/Sauer_Buildings_Historic_District.html

https://fatherpitt.wordpress.com/2015/02/28/the-sauer-buildings-in-aspinwall/

# DID YOU KNOW . . . ?

Pterosaurs, the flying reptiles that lived side by side with the dinosaurs, were the first vertebrates to achieve true flapping flight. Because they are extinct, however, many questions about their biology and lifestyle remain unresolved. They had some sort of furry covering, called “pycnofibers,” that was long thought to have been fundamentally different from the feathers of dinosaurs and birds.

Birds have advanced feathers for use in flight and for body smoothing, contour feathers with a hollow quill and barbs down both sides. These are found only in birds and those theropod dinosaurs close to bird origins. Modern birds also have other feather types that include monofilaments and down feathers, feather types seen much more widely in dinosaur and pterosaur fossils.

Now, an analysis of two pterosaur specimens from the Middle-Late Jurassic Yanliao Biota (~ 165–160 ma) in Inner Mongolia, China, with well-preserved pycnofibers indicates that pterosaurs had at least four types of feathers: 1) simple filaments (hairs); 2) bundles of filaments; 3) filaments with a tuft halfway down; and 4) down feathers. This discovery has implications for understanding the origin of feathers, but also for a major time of revolution of life on land.

Feathers evolved about 250 ma when life was recovering from the end-Permian mass extinction. Using high-powered microscopes to examine the two pterosaur specimens, the researchers found many examples of all four feather types. Although some critics suggest there is only one simple type of pycnofiber, the new studies show the different feather types are real. The researchers focused on clear areas where the feathers did not overlap and where they could see their structure clearly. The feathers even show fine details of

**Reconstruction of a Mongolian pterosaur that had four different feather types.**

melanosomes that are suspected of giving the fluffy feathers a ginger color.

Based on evolutionary analyses, the pterosaur pycnofibers clearly are feathers, just like those seen in modern birds and across various dinosaur groups. Despite careful searching, the researchers could find no anatomical evidence that the four pycnofiber types were any different from the feathers of birds and dinosaurs. Since they are the same, they must share an evolutionary origin that occurred long before the origin of birds.

**http://www.sci-news.com/paleontology/pterosaur-feathers-06733.html**

And speaking of birds and fossil fliers, a team of paleontologists working with the Institute of Vertebrate Paleontology and Paleoanthropology and the Center for Excellence in Life and Paleoenvironment at the Chinese Academy of Science has discovered a new species of bird-like dinosaur with pterosaur-like wings. The new dinosaur, named *Ambopteryx longibrachium* sheds light on the origins of avian flight.

*Ambopteryx*, a member of the Scansoriopterygidae, an extinct family of climbing and gliding non-avian theropod dinosaurs, lived about 163 ma in what is now China. A nearly complete skeleton was found near Wubaiding Village in the Liaoning Province. The animal had a body length of about 12.6 in. and an estimated body mass of 10.6 oz. Scansoriopterygids are different from other theropod dinosaurs in, among other things, the proportions of the forelimbs that support a strange wing structure. Unlike birds, *Ambopteryx* had membranous wings supported by a rod-like wrist bone found in pterosaurs and flying squirrels, but unlike any found in other dinosaurs.

***Ambopteryx longibrachium*, a small Jurassic dinosaur with membranous wings.**

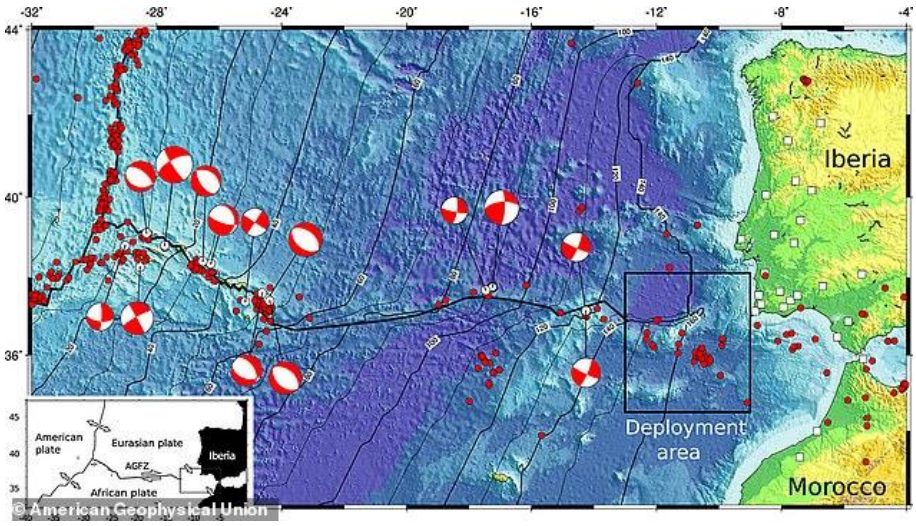
Only one other similar dinosaur fossil had been found previously, an incomplete specimen called *Yi qi*. Because of *Yi*'s preservation, the unique wing structures and their precise function were not completely understood. *Ambopteryx*, though, preserves both the membranous wings and the rod-like wrist, which represent a short-lived and unsuccessful attempt to fly. They also support their probable widespread presence in other scansoriopterygids.

Feathered wings, which were first documented in Late Jurassic dinosaurs, ultimately became refined through the evolution of numerous skeletal and soft tissue modifications. These gave rise to at least two additional independent origins of dinosaur flight, leading eventually to the origin and evolutionary success of modern birds.

**http://www.sci-news.com/paleontology/ambopteryx-longibrachium-07170.html**

Strange things are occurring off the coast of Portugal. Scientists have wondered for years about an apparently monotonous expanse of ocean floor off the coast of that country. In 1969, a massive earthquake originating somewhere in this expanse rattled the shore and generated a tsunami. The broad, featureless surface of the seabed doesn't appear to have any tectonic aspects that would generate an earthquake. So what was going on?

Now, 50 years after the 1969 earthquake, a team of scientists from the University of Lisbon has proposed a radical explanation. According to his computer simulations the bottom of the tectonic plate off Portugal's coast seems to be peeling away from its top, providing the trigger for one plate to begin diving beneath another in a subduction zone. If confirmed, this would be the first time anyone had found evidence of an oceanic plate beginning to subduct, possibly indicating an early stage in the shrinking of the Atlantic Ocean that would eventually have Canada and Europe colliding millions of years in the future.




**Map of the eastern Atlantic Ocean off Iberia, showing the Horseshoe Abyssal Plain with its unusual seismic activity.**

The model obviously needs further testing, not an easy job when you consider that the necessary data would be coming from a natural process working at the speed of growing fingernails. The team acknowledges that there is still work to do but for now. Their hypothesis was presented at a conference, but the team is currently working on preparing their research for publication so their data can be more widely reviewed and debated.

**https://www.nationalgeographic.com/science/2019/05/tectonic-plate-peeled-apart-could-shrink-atlantic-ocean-geology/**

It turns out all songbirds are related. An international research team of recently discovered that all songbirds have an additional chromosome called the 'germline restricted chromosome' (GRC) in their germ cells. As we know from our Biology 101 class, normal cells have two copies of each chromosome. Germ cells, the cells that end up being sperm or eggs, typically have the same set of chromosomes as a normal cell, but once they develop into an egg or sperm, only one copy of each chromosome is included. GRC, which occurs in female germ cells, is transmitted from mother to offspring, but it typically is discarded from all normal cells of the offspring during early development. GRC also occurs in male germ cells, but is discarded before the germ cells turn into sperm. Therefore, GRC is not passed from father to offspring.

That said, GRCs have been reported in zebra and Bengalese finches, two related species of the family Estrildidae. These, however, were considered a genetic oddity. Until, that is, the international research team performed a comprehensive comparative cytogenetic study of GRCs from 24 bird species representing eight orders. They made a sequence-based comparison of the GRC probes from four distinct songbird species that showed that GRCs are a key feature helping identify songbirds as a phylogenic group.

The team found no GRCs in any non-songbirds (e.g., chicken, terns, swifts, falcons, and parrots) and concluded that the GRC has formed in the common ancestor of all songbirds about 35 ma (Late Eocene) as a small additional chromosome. Over millions of years, this chromosome evolved in size and genetic content, transforming into an important component of the songbird germ cell genome. The researchers found it tempting to think that GRC might have enabled songbirds to become the most species-rich order of birds, allowing them to evolve endless forms, and invade many different ecological niches on all continents. Because the birds' germ genomes have more genes than other birds, the team suggested, it could have created more opportunities for adaptation and speciation.

Of course, such thinking typically leads to other questions. Birds are the only group of dinosaurs that survived the K/Pg extinction event. Is it possible that the extinct dinosaurs, like their avian relatives, also had GRCs that would have made them so diverse?

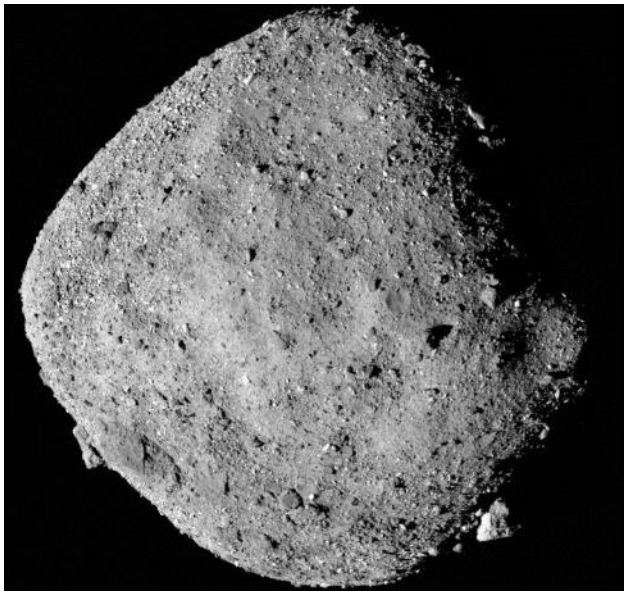
**A male Indigo Bunting, a common songbird found in the eastern U.S.**

**http://www.sci-news.com/biology/songbirds-germline-restricted-chromosome-07160.html**

Scientists currently are grappling with just how much water might be found in outer space, and they are looking specifically at near-Earth asteroids as a potential source of water. So far, astronomers have found about 20,000 such asteroids, some of which have been observed and photographed up-close by missions such as Japan's Hayabusa2 and NASA's OSIRIS-REx that are currently orbiting such objects. Although not all of the rocks out there carry water, some do and those are the ones of interest.

Scientists know from meteorite studies that some asteroid compositions include minerals with water in them. NASA's OSIRIS-REx mission proved that soon after its arrival at Bennu, a near-Earth asteroid, when it detected hydrated minerals.

Mapping water across the solar system is important because water, which can be split into $H_2$ and $O_2$, might eventually be used to make rocket fuel. If that becomes common practice, the price of trips into space and back would be reduced significantly. Rockets leaving Earth would no longer have to be powerful enough to lift the weight of all their needed fuel. They could simply "gas up" at a nearby asteroid "gas station."



**A mosaic image of the asteroid Bennu collected in December 2018 by *OSIRIS-REx* from 15 miles away.**

A team of planetary scientists has been calculating the potential water in asteroids using ground-based telescopes. By combining those observations with other measurements, as well as data on meteorites, the team calculated a basic estimate between 100 billion and 400 billion gallons of water spread among the near-Earth asteroids. The team would like to run similar calculations based on data gathered from space, of course, because Earth's atmosphere tends to interfere with the direct signature of water, keeping ground-based observations uncertain. Fortunately for them, the James Webb Space Telescope,

which would greatly improve measurements, is currently planned to be launched in 2021.

**https://www.space.com/amp/how-much-water-in-asteroids.html**

Scientists have discovered a 100 ma mosquito perfectly preserved in amber. They hope it will shed light on the origins of malaria, a disease that kills over 400,000 people each year. A team of researchers from Oregon State University has been studying the fossilized mosquito inside the mid-Cretaceous-age amber found in Myanmar. While the mosquito represents a new species, it shares many similarities with mosquitoes still buzzing about today, such as the *Anopheles* mosquitoes that are famous for transmitting malaria. The two are similar in wing veins, antennae, abdomen, and proboscis, suggesting that the Cretaceous mosquito represents an early group of today's disease vectors. As such, it could have been carrying malaria to Cretaceous birds, small mammals, and reptiles, the groups of animals anopheline mosquitos feed on today. It is also possible that the dinosaurs may have been infected.

**Photo of a mosquito trapped in amber.**

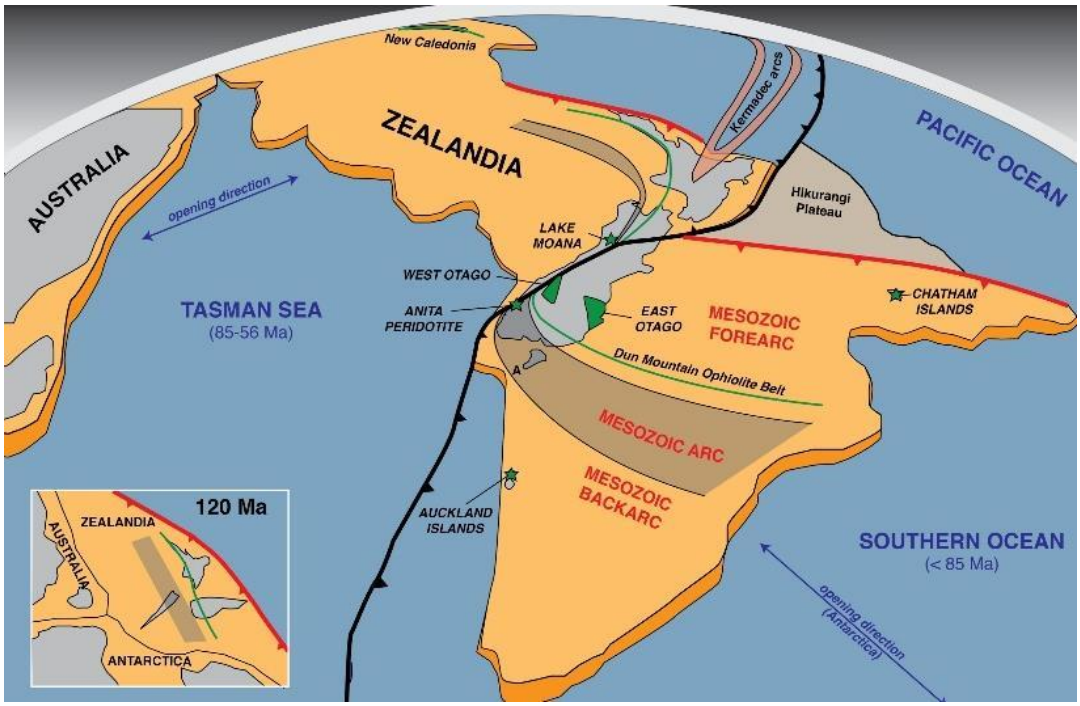
A number of parasites belonging to the genus *Plasmodium* cause malaria when infected female mosquitoes bite animals to feed on their blood and the parasite is transmitted. The World Health Organization estimates that almost 1/2 half of the world's human population is at risk of malaria, and those living in sub-Saharan Africa are most at risk. Malaria infections can be treated, but there is as yet no effective vaccine. Prevention, therefore, in the form of insecticides and mosquito nets, is the only way to stop infection.

The Oregon study suggests that Cretaceous anopheline mosquitos could have spread throughout Gondwana before plate tectonics divided the continent into what is now Africa, South America, Madagascar, India, Australia, Antarctica, and Arabia. That would certainly explain how *Anopheles* mosquitoes have become widespread across the globe. The team pointed out that the fossilized mosquito came from Myanmar, a country thought to have been part of Gondwana 100 ma.

*Plasmodium* was actually found in a 15 to 20 ma fossilized mosquito from the Dominican Republic, the first time the parasite had been found in fossil form. Fossil evidence, therefore, shows that modern malaria carried and transmitted by mosquitoes is at least 20 million years old, and earlier forms of the disease that were carried by biting midges are at least 100 million years old, probably much older than that. Learning more about the evolution of malaria and its relationship with mosquitoes could aid scientists in finding new methods of tackling the disease.

**https://www.iflscience.com/plants-and-animals/100millionyearold-amber-fossil-suggests-mosquitoes-carried-malaria-when-dinosaurs-walked-the-earth/**

As explained in the March 2017 issue of the PGS Newsletter, New Zealand represents parts of a large undersea continent known as Zealandia. A team of scientists analyzed a mix of isotopes in seafloor samples from different parts of the Earth to determine what mantle domain produced them.




**Map of Zealandia showing some of the localities where ultramafic rocks occur.**

Since most of the rock on or near Earth's surface was, at some point, part of the planet's molten interior, different domains of the interior contain different ratios of various isotopes. Therefore, they produce different compositional signatures. Scientists studying the Australian-Antarctic Ridge (AAR), the area including Zealandia, have determined that it has a unique chemical signature indicating the samples must have emerged from a domain that was previously unknown. This 1,200-mile-wide region was a final gap in the geological model of the seafloor.

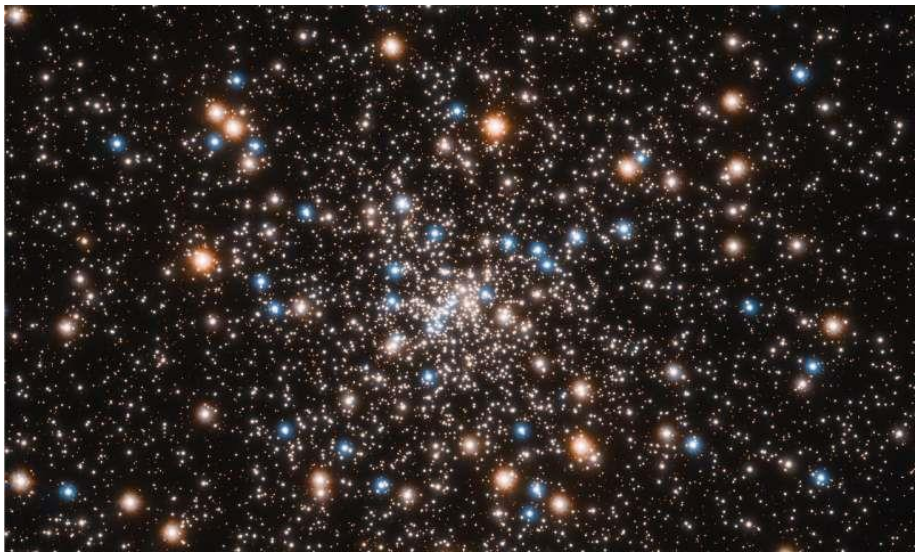
Previously, scientists had predicted that the AAR would have a similar isotopic signature to the Pacific, indicating the two ocean floor regions came from the same part of the mantle. The AAR appears, instead, to have arisen separately from its own part of the mantle, possibly as part of a major geologic disruption that occurred during the Late Cretaceous about 90 ma when Gondwana broke up. At that time, a deep mantle upwelling dubbed the Zealandia-Antarctic Swell seems to have pushed its way between the separating continental plates, forming the relatively shallow seafloor of the AAR.

That is the last part of the ocean's mantle domain identified. But it probably will not end the discussion of how this new mantle domain has interacted with the previously-established ones throughout geologic time to produce the Earth we see today.

**https://amp.livescience.com/64737-antarctic-new-mantle-ocean.html**

Astronomers from Italy and the UK recently used supermassive black holes formed just after the Big Bang to measure the expansion rate of the Universe (the Hubble Constant), which has been incredibly difficult to determine. It seems like every test came up with a different result. Last year, a cepheid variable star calculation of the Hubble Constant resulted in 45.6 miles per second per megaparsec. More recent data from the Planck satellite measuring the cosmic microwave background set the constant at 41.9 miles per second per megaparsec, with less than 1% uncertainty.

A few years ago, astronomers realized that the distance to another object such as a quasar could be calculated precisely also. Quasars, some of the brightest objects in the Universe, are galaxies orbiting supermassive black holes. Material around the black hole (an accretion disc) emits intense light and heat from friction as it swirls into the black hole like water in a drain. Accretion discs also emit X-ray and ultraviolet light. The Italian-British astronomy team recently found the ratio of these two quasar-produced wavelengths varies depending on the ultraviolet luminosity. Once they were able to determine the luminosity, as calculated from that ratio, they were able to use the quasar just like any standard candle, allowing them to measure farther back into the Universe's history.



**NGC 6397, one of the closest globular clusters to Earth, was recently measured by the Hubble Telescope at 7,800 light-years away, with just a 3% margin of error.**

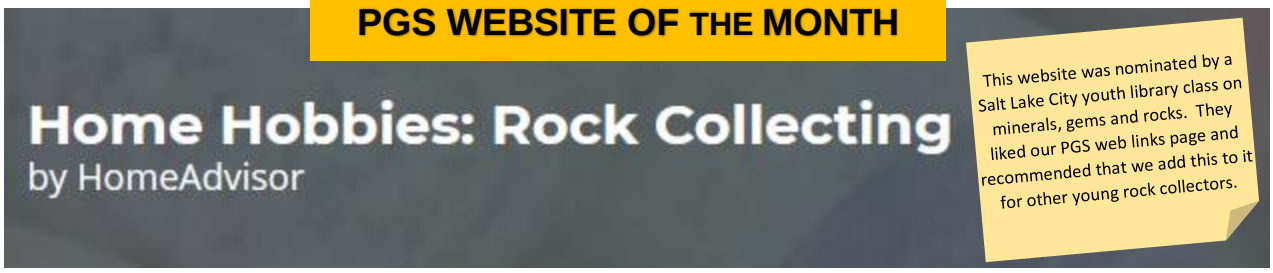
The researchers compiled UV data on 1,598 quasars from 1.1 ga to 2.3 ga after the Big Bang, and then used their distances to calculate the expansion rate of the early Universe. They also compared their results against the supernova results covering the more recent 9 ga and found similar results where the data overlapped. In the early Universe, where only quasars provide measurements, however, there was a discrepancy between what they observed, and what the standard cosmological model predicted. They found that the Universe's expansion rate up to the present day was faster than expected.

What does this mean? It is possible that the dark energy thought to be driving the acceleration of universe expansion (sometimes interpreted as the cosmological constant described by Albert Einstein), is not so cosmologically constant after all. Rather, it could be growing stronger as it gets older. Since we can't see it or detect it, we don't actually know what dark energy is. It is just a name given to an unknown repulsive force that seems to be accelerating the Universe's expansion over time.

Astrophysicists have calculated that dark energy comprises about 70% of the Universe, based on that expansion rate. A more accurate expansion rate would give astronomers a more accurate calculation of dark energy volume. If the density of dark energy really is increasing over time, the scientists think that means it isn't Einstein's cosmological constant after all. It would explain the strange numbers, however, and possibly even explain the discrepancy between the previously published Hubble Constant results.

**https://www.sciencealert.com/the-universe-is-expanding-faster-than-we-thought-it-might-take-new-physics-can-explain-it/amp**

## PGS WEBSITE OF THE MONTH




**https://www.homeadvisor.com/r/rock-collecting/**

## PGS Board-of-Directors

| | | | | | |
|---|---|---|---|---|---|
| **President:** | Tamra Schiappa | **Director-at-Large:** | Wendell Barner | **Director-at-Large:** | Mike Keeliher |
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| | | | | |
|---|---|---|---|---|
| *Other PGS Positions*: | **Newsletter Editor / Webmaster**: | Karen Rose Cercone | **Historian:** | Judy Neelan |
| | **AAPG Delegates:** | Dan Billman / TBD | **Continuing Ed:** | Brian Dunst |

**Officer Contacts**: If you wish to contact a PGS Officer, you can email Tamra Schiappa, President, at tamra.schiappa@sru.edu; Dan Harris, Vice President at Harris_D@calu.edu; Kyle Fredrick, Treasurer, at fredrick@calu.edu; or Diane Miller, Secretary, at dmiller@appliedgeology.net.

**Memberships**: For information about memberships, please write PGS Membership Chair, PO Box 58172, Pittsburgh PA 15209, or e-mail jharper.pgs@gmail.com. Membership information may also be found at our website: www.pittsburghgeologicalsociety.org.

**Programs:** If you would like to make a presentation at a PGS meeting or have a suggestion for a future speaker, contact Dan Harris, Program Chair at Harris_D@calu.edu.

**Newsletter**: To contact the Newsletter Editor, Karen Rose Cercone, with questions or suggestions for articles, job postings or geological events, please email kcercone@iup.edu.

**Facebook:** Follow the PGS at https://www.facebook.com/PittsburghGeologicalSociety

**Twitter:** PGS can be followed on Twitter by searching out the username @PghGeoSociety

**LinkedIn:** To join the PGS Group, click https://www.linkedin.com/groups/12018505

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

The highest mileage ever recorded for an automobile was 2,970,000 miles, for a 1966 Volvo P1800-S owned by a retired science teacher from Long Island, New York.

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