



PGS Newsletter

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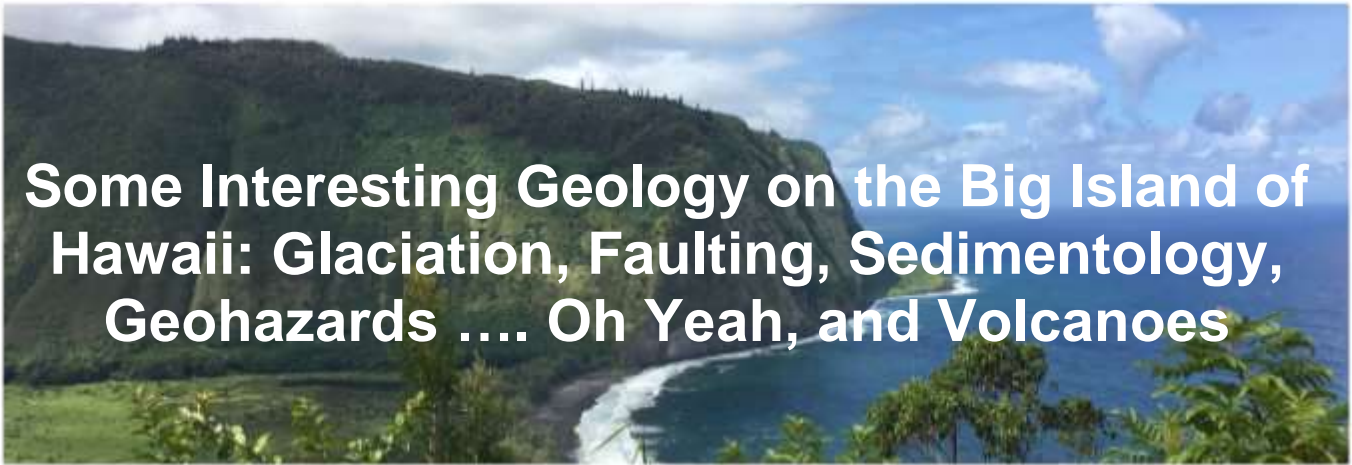


Vol. LXIX, No. 4

Karen Rose Cercone, Editor

December 2016

Wednesday, December 21, 2016



Some Interesting Geology on the Big Island of Hawaii: Glaciation, Faulting, Sedimentology, Geohazards Oh Yeah, and Volcanoes

DAN A. BILLMAN, P.G., C.P.G.
President, Billman Geologic Consultants Inc.

The AAPG Foundation Trustee Associates meet yearly, typically in a favorable location, to discuss the continued funding of programs, such as AAPG's Grants-in-Aid, Visiting Geologists, Distinguished Lecturer, etc. This year's meetings were held on the Big Island of Hawaii. As all the AAPG Trustees are geologists first, typically the event includes a fieldtrip of the area and this year was no exception.

As a petroleum geologist, I was looking forward to learning a little more about volcanoes; really only knowing the basics. I came to find out there is a lot more geology on the island than just volcanology. Although everything geologic on the island has the imprint of volcanism on it, we came to find out that the island has gone through numerous glacial periods, has an interesting set of sub climates that effect the sedimentology along the edges of the island, and has an interesting tectonic history (or should I say very recent history).

Through photos taken on the trip and dissecting the fieldtrip guide, we'll go through some of the non-volcanic geology of the Big Island and of course, look at a couple volcanoes, too.

Social hour - 6:00 p.m.

Dinner - 7:00 p.m.

Program - 8:00 p.m.

Dinner costs \$30.00/person, students \$10.00; checks preferred. For reservations, please email your name and number of attendees in your party to pgsreservations@gmail.com. You can also reserve and pay for dinners via PayPal on our website <http://pittsburghgeologicalsociety.org>. Please include your name and number of attendees in your party. Deadline for reservations is noon on Monday, December 19.

Meeting will be held at Foster's Restaurant, Foster Plaza Building 10, Green Tree.

SPEAKER BIOGRAPHY



Dan Billman has over twenty-six years of experience in the Appalachian Basin with the last twenty-three as a consulting geologist and president of Billman Geologic Consultants, Inc. Prior to independent consulting, Dan worked as an exploration and development geologist for Mark Resources Corporation and Eastern States Exploration Company. Mr. Billman is a registered Professional Geologist (PG) in the state of Pennsylvania and an American Association of Petroleum Geologist, Certified Petroleum Geologist (CPG).

Mr. Billman received his Bachelor of Science degree in Geology from the University of Toledo (Ohio) and his Master of Science degree in Geology from West Virginia University. He is a member of the American Association of Petroleum Geologists (AAPG) and is currently one of two AAPG Delegates representing the Pittsburgh Geological Society. Mr. Billman is a board member of the Pennsylvania Council of Professional Geologists and current President-elect of the organization; becoming president of PCPG on January 1, 2017.

ABOUT THE AAPG FOUNDATION

The American Association of Petroleum Geologists (AAPG) Foundation exists to support the geosciences. Since 1967, the AAPG Foundation has provided funding for a variety of educational and research programs that benefit the geologic profession and the general public. The Foundation continues to promote a better understanding and advancement of the geosciences through the dissemination of technological information, recognizing outstanding achievements and by funding grants, publications and other initiatives that support the preservation of data, training and career enhancement for current and future geoscientists. Through the financial support of many generous donors, the AAPG Foundation reaches thousands of people each year.



PRESIDENT'S STATEMENT



They say time flies faster with age and it sure seems like it to me. 2016 is coming to an end but it doesn't feel like I've been a member of the PGS Board of Directors for almost two and a half years. They also say that time flies when you're having fun--and I buy that one too. One reward of my service as your president is experiencing the generosity of our donors and it is this time of year when we jump start our annual Corporate Sponsorship campaign. Sponsorship letters and forms have recently been mailed to current, past, and prospective sponsors whose monetary contributions to the Society are the life blood that supports our monthly operations and initiatives.

(President's statement continues on next page.)

PRESIDENT'S STATEMENT (CONTINUED)

And the initiatives are many. Among other activities, we are continuing to: 1) secure top-flight speakers for nine monthly meetings each year; 2) provide Continuing Education Credits (CEUs) to licensed professional geologists for attendance at the meetings; 3) provide networking and training opportunities to students; 4) supply judges to science and engineering fairs for budding scientists; 5) collaborate with earth science teachers through community-minded outreach to develop critical curricula for the next generation of geologists; and 6) provide annual field trips for our professional and student members to keep all in touch with geology in the field, just to name six. If your company has not been approached and you would like to support the Society, speak to any Board member and we will gladly provide you with a sponsorship form. The forms can also be found on our website. Contributions can be directed to our general fund or to the Galey Fund that supports student initiatives.

And speaking of jump starting, I'm pleased to acknowledge commitments of support for 2017 already received from three companies; Falcede Energy Consulting, LLC (formally ARK Resources), Barner Consulting, LLC, and Groundwater & Environmental Services, Inc.



*Serving the Heart
of Western Pennsylvania*

*220 South Jefferson Street,
Suite B, Kittanning, PA*

Above and beyond corporate sponsorship is the PGS Endowment Fund, established in May 2014 through the Community Foundation Serving the Heart of Western Pennsylvania. In accordance with the mission of the Foundation, the Fund is to be used for the charitable purpose of the support of the Society in the years to come. The "charitable purpose" of the Fund may be applied, in whole or in part, to the monetary needs of students (awards, membership, student meeting subsidization), community outreach, field trips, educational seminars, monthly operations, or whatever the Society's Board defines as a given charitable need.

In essence, the Fund will provide a financial vehicle to protect the future longevity of the Society, in existence since 1945, for many years to come. Contributions can be made through bequests, memorials, and gifts to the Pittsburgh Geological Society / Endowment Fund or directly to the Community Foundation Serving the Heart of Western Pennsylvania. You are encouraged to make your gift in honor of someone. All contributions are tax deductible. If you wish to seek any further information on the Fund feel free to contact me or **Mindy Knappenberger**, the Executive Director for the Community Foundation at (724) 548-5897 or mindy@servingtheheart.org.

I hope you'll join us for our December meeting on the 21st. The December get-together is commonly referred to as Family Night and members are encouraged to bring their spouses or significant others. We purposely make our talks at this meeting more accessible for non-geologists. For this month's meeting, Dan Billman, one of PGS's two AAPG Delegates, will help us (on the first night of winter) imagine life in a warm climate by talking about his latest trip to Hawaii. See you then.

Peter R. Michael
President

IN MEMORIAM

MAURICE DEUL

1921 – 2016



Maurice “Maury” Deul, a long-time PGS member, passed away on November 8, 2016. He was born in Jaffa, Palestine and immigrated to America in 1923 at the age of 2 with his parents the late John and Zina. Raised in Schenectady, New York, Maury attended Union College graduating in 1942. He served in the Army during WWII where his unit fought in the invasion of Sicily. Once home again, he married his teenage sweetheart, the late Murriel Deul, and had two daughters, Susan and Judy.

Coal brought Maury to Pittsburgh in 1957, where he pursued his interest in geology working for Bituminous Coal Research, Consolidated Coal Company, the U. S. Bureau of Mines and after retiring, teaching at the University of Pittsburgh. “I have had a sort of a romantic adventure with coal for nearly a half century,” he told GeoTimes magazine in 2001. He saved lives with his work on methane control in coal mines. His leadership in developing a methane drainage program while at the U.S. Bureau of Mines resulted in advanced technologies and methods that are widely used for detection, dispersion and drainage of coal-bed methane. In 2001, the Pittsburgh Coal Mining Institute of America awarded him the Donald S. Kingery Memorial Award in recognition of his work to improve mine safety and health. Maury Deul was the first geologist ever to receive this award.

Maury was a distinguished member of the Society of Mining Engineers and a past chairman of the Pittsburgh Section of the Society for Mining, Metallurgy and Exploration. In 1996, he was recognized by the North American Coalbed Methane Forum as a pioneer in this field. He was a long-time member and supporter of the Pittsburgh Geological Society, where he never failed to stop and chat with new student members at every meeting he attended.

Maury gave back in many ways to the Pittsburgh community, serving as president of Beth El Congregation and as president of Covenant (now Concordia), as well as volunteering for over 35 years at Jubilee Kitchen. His many passions outside geology included opera, classical music, reading, playing bridge and gardening.

At the November PGS Board meeting, the Awards Committee recommended that Maurice “Maury” Deul (posthumously) be the sixteenth recipient of the Walt Skinner Award. The Pittsburgh Geological Society established the Walt Skinner Award in 1987 to honor those members who have provided exceptional service to the Society and to the geological community at large. This award is named for Professor Walter S. Skinner of Duquesne University, a long-time member of the Society, who served as President, officer, and board member.

GEOLOGICAL EVENTS

GEOPHYSICAL SOCIETY OF PITTSBURGH & PITTSBURGH AREA PETROLEUM GEOLOGISTS JOINT MEETING

December 6, 2016

SEG Distinguished Lecturer Scott Michell, BP Oil -- "Subsalt Imaging: Snapshots in Time, Reflections, and Next Steps".
Cefalo's Event Center, Carnegie PA.

GEO-INSTITUTE – PITTSBURGH CHAPTER

December 8, 2016

Dr. Andrew Bungler, University of Pittsburgh -- "How Hydraulic Fracturing Changed an Industry and How Research is Changing Hydraulic Fracturing"
Gaetano's Restaurant, Pittsburgh, PA

PENNSYLVANIA COUNCIL OF PROFESSIONAL GEOLOGISTS

December 13, 2016

Vapor Intrusion Technical Guidance Seminar,
Regional Learning Alliance, 850 Cranberry Woods Drive, Cranberry PA

GREATER PITTSBURGH SECTION OF THE ASSOCIATION OF ENGINEERING AND ENVIRONMENTAL GEOLOGISTS

December 15, 2016

Dimi Apostolopoulos, Robotics Institute of Carnegie Mellon University and the National Robotics Engineering Center – "Low-Profile Robotic Platform Capable of Handling the Challenges of a Heavily Constrained Mining Environment While Mapping and Performing Remote Inspection"
Foster's Restaurant, Greentree PA



The Pittsburgh Geological Society welcomes the following new members:

Abbey C. Nilson

Earth/Space Science Teacher
Shaler Area School District

Katharina N. Pankratz

Student Member
California University of Pennsylvania

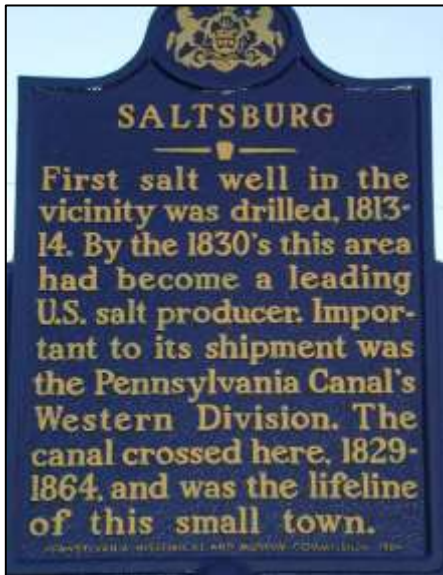


LOOK FOR PGS ON LINKEDIN!

You know we have a website, and most likely have liked us on Facebook and have received a tweet or two from our Twitter account. And now we are on LinkedIn. Please search for Pittsburgh Geological Society and join our group.

If you have not joined LinkedIn, what are you waiting for? Please join, especially you students. This is a good way to build a professional network that can assist you in finding a new job and develop new business leads and contacts you can connect with and share throughout your career.

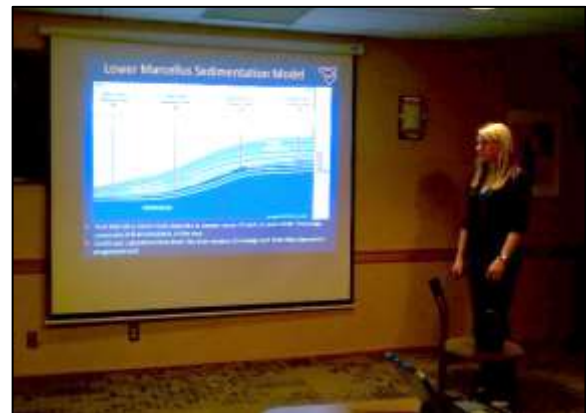
UPCOMING EVENTS OF INTEREST TO PGS MEMBERS



SATURDAY, APRIL 8, 2017 PGS SPRING FIELD TRIP

PGS will sponsor a one-day field trip that examines the geology and industrial history of the Western Division of the Pennsylvania Main Line Canal in southern Indiana County. Participants will visit the type location of the Saltsburg Sandstone, and examine paleosols and stream channels in a section of the Glenshaw Formation exposed along Bow Ridge near the Conemaugh River Lake. Additional stops will be made at the Rebecca Haddon Stone House Museum in Saltsburg, the Tunnelview Historic Site, and the US Army Corps of Engineers Conemaugh River Lake flood control dam near Tunnelton PA. A detailed itinerary and other logistics will be announced in the January PGS newsletter.

15th ANNUAL PGS / AEG / ASCE STUDENT NIGHT APRIL 19, 2017



Students will once again have the chance to present their research at the 15th Annual Student Night on April 19, 2017 at Foster's Restaurant, #10 Foster Plaza, Greentree. If you have been conducting undergraduate or graduate research in any geological or geotechnical field, here is an opportunity to show off your work to members of the three professional scientific societies, and receive the benefits that go along with it. Students who present their original research grow from the experience by improving their public speaking skills, networking with professionals and experts in their fields, listing a presentation on their resume and possibly winning a cash award.

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

Professors: please pass this information on to your students who are doing research and encourage them to submit abstracts this coming spring.

THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES



Historic S-Bridge over Buffalo Creek in Claysville, Washington County

Claysville, in western Washington County, owes its existence to the National Pike (US Route 40), the first major, improved highway built in the country between 1811 and 1837 by the Federal government. Sometime around 1800, John Purviance erected a tavern where Claysville now sits. In 1817, when he heard that the National Pike was coming through the area, he laid out a town named in honor of Henry Clay, the Kentucky Senator who was the chief advocate for the pike.

Once the road was built, the town grew rapidly and was finally incorporated as a borough in April, 1832. Many hotels sprang up in the town at various times from 1820 until about 1857 when the Wheeling, Pittsburgh and

Baltimore Railroad was completed through town, and travelers preferred riding the rails to heading west in wagons. During the Civil War, Claysville was known as “Little Richmond” because of its strong Democratic leanings (supposedly there was only one Republican in town). Claysville is home to a historic "S" bridge on the old National Pike. It was made of stone and helped transport wagons and stagecoaches over Buffalo Creek. The Pennsylvania Historical and Museum Commission installed a historical marker in 1947 and the Washington County History & Landmarks Foundation has also designated it a historic bridge.

DID YOU KNOW . . . ?

Eighteenth-century English dairymaids were, unintentionally, some of the first paleontologists. Before measurements became standardized, dairymaids often used “pound stones”, commonly found in the fields of Oxfordshire, to weigh butter and cream. The pound stones were very useful because they were all uniform in size, shape, and weight. But although the dairymaids knew the practical value of pound stones, very few people of any skillset realized their scientific importance.

These “rocks” were circular, flat on the bottom, and had markings on the top that indicated 5-fold symmetry. They very closely resembled the sea urchins living in the waters off the coast. As it turns out, pound stones (also called Chedworth buns) really WERE sea urchins - fossilized sea urchins. It took a while for geology and paleontology to catch up with the dairymaids, but eventually geologists came to realize that pound stones were not only weights, but signs of ancient oceans that once covered England.

A pound stone is a species of Jurassic sea urchin called *Clypeus plotii* (Leske). It can still be found in Jurassic limestones in England and continental Europe.



***Clypeus plotii*, the Jurassic sea urchin fossil once used as pound stones in England**

(Thanks to Dr. Norman Samways for suggesting this news item.)

New research suggests that climate change may impede the cooling effect of volcanic eruptions. When an eruption is powerful enough, the volcano or volcanoes spew sulfur gasses into the atmosphere as high as the stratosphere, about 6 to 9 miles above the Earth's surface. These gasses react with water to form aerosol particles that linger in the stratosphere for up to two years, reflecting sunlight and heat from the sun, and cooling the planet. In an average year, there are anywhere from 3 to 5 eruptions whose plumes reach the stratosphere. Research has shown that, as the planet warms, the lower layers of the atmosphere expand, making it harder for volcanic gasses to reach the stratosphere. Instead, they quickly turn into aerosols and clouds in the troposphere and precipitate back down to Earth as rain or snow.



Some volcanic eruptions are large enough to decrease global temperatures

Although the planet continues to warm, there has been a slight decline in the rate of warming over the last 10 to 15 years caused in part by the number of large eruptions over the last decade that have sent sulfur gasses high up into the stratosphere. According to climate model projections and global warming, the amount of volcanic sulfur gasses in the stratosphere will decrease anywhere from 2% to 12% in the next 100 years. If this continues, humanity could see anywhere from 12% to 25% less sulfur gas in the stratosphere by the 22nd and 23rd centuries. The exact range is large because it is difficult to predict future eruptions and future greenhouse gas emissions. It has been speculated that this

mechanism may have contributed to Earth's entry into the long period of global glaciation during the Late Precambrian, around 700 million years ago (during the time of Snowball Earth).

A Late Triassic tree-dwelling reptile called *Drepanosaurus* apparently had a humongous claw at the end of the second finger of its front paw. Previously known only from badly preserved fossils from Italy, new 220 ma fossils of the creature were discovered in New Mexico. It was neither a dinosaur nor a lizard, but rather a member of a group of reptiles with lizard-like bodies and hands and feet adapted for specialized grasping. *Drepanosaurus* also had grasping feet and a claw-like structure at the tip of its tail. Because of the strange (for its time) forelimb with the big claw, researchers see *Drepanosaurus* as a kind of combination chameleon and anteater.

The two bones of the forelimb of all tetrapods, the radius and ulna, connect to a series of much shorter wrist bones at the base of the hand. In most tetrapods, the radius and ulna are parallel, but in *Drepanosaurus* the ulna is a flat, crescent-shaped bone and the two wrist bones meeting the end of the ulna, rather than being short, are longer than the radius. The bone contacts suggest that the enlarged claws were used to hook into insect nests. If so, the entire arm may have been able to be powerfully retracted to tear open the nest, similar to the hook-and-pull digging of living anteaters. So, it is entirely possible that some tetrapods developed specialized, modern ecological roles over 200 million years ago.



Artist's reconstruction of *Drepanosaurus*

Long before trees, or even lichens evolved, soils were alive on Earth. That's the conclusion of a team of researchers from the University of Oregon who closely examined microfossils in 3 billion years old rocks in Pilbara region of Western Australia. The rocks were long thought to be of marine origin, but when the team took a closer look at the them, dusty salt minerals in the rocks suggested they had to have experienced evaporation on land. Other mineral and chemical tracers found in the rocks also required weathering in soils. The microfossils indicate that life was not only present but thriving in soils of the early Earth, as much as 2/3 of the way back to its formation.



Three billion year old rocks in Western Australia

The researchers described a microbiome of at least five different kinds of microfossils recognized from their size, shape and isotopic compositions. The largest and most distinctive microfossils are spindle-shaped hollow structures of mold-like actinobacteria, still a mainly terrestrial group of decomposers that are responsible for the characteristic earthy smell of garden soil. Other sphere-shaped fossils are similar to purple sulfur bacteria that photosynthesize organic compounds in the absence of oxygen while leaving abundant sulfate minerals in the soil. The team found cell densities of over 1,000/mm² and a diversity of producers and consumers, indicating a fully functional terrestrial ecosystem, providing evidence that life in soils was critical to the cycles of carbon, phosphorus, sulfur, and nitrogen very early in the history of the planet. The ancient soils

with sulfate salts and microfossils are superficially similar to those found recently by the Mars rover Curiosity, so they might be useful guides for the discovery of life on other planets.



Outcrop of part of the Foreknobs Formation in Huntingdon Co. PA

The Greenland Gap Group is a succession of Upper Devonian sandstones, siltstones, and shales named by Dr. John Dennison of the University of North Carolina in 1970. Formerly called the Chemung Formation, an old, out-of-date New York name, the group consists of the lower Scherr Formation and the upper Foreknobs Formations. These two are distinguished by the percentages of coarse-grained rocks. The Scherr typically consists mostly of shale and siltstone with some relatively minor sandstone beds, whereas the Foreknobs consists of shale and siltstone with more numerous, coarser-grained, and thicker sandstone beds. In Pennsylvania, the term Greenland Gap Group is not commonly used, but Foreknobs and Scherr are accepted names in outcrop in south-central Pennsylvania, and in the subsurface of Somerset and part of Cambria County. In the vicinity of Altoona, the two formations grade laterally into the correlative Lock Haven Formation, which is recognized in outcrop throughout north-central and northeastern Pennsylvania. Both the Foreknobs-Scherr interval and the Lock Haven Formation are facies equivalents of the somewhat younger Elk and Bradford groups in the subsurface of western Pennsylvania.

An international team of paleontologists has discovered and named a new species of dinosaur from the Late Cretaceous of southern China. *Tongtianlong limosus*, meaning “muddy dragon on the road to heaven,” belongs to a family of feathered dinosaurs called oviraptorosaurs that are characterized by having short, toothless heads and sharp beaks. Some of these, including the newly-discovered species, had bony crests on their heads like modern-day cassowaries that were probably used for display and attracting mates.

The new dinosaur includes a nearly complete, 3D-preserved skeleton, including skull and lower jaws, collected from the Nanxiong Formation in the Ganzhou area of Jiangxi Province in southern China. It was preserved almost intact, lying on its front with its wings and neck outstretched. This is the sixth species of oviraptorosaur named from the Nanxiong Formation in the past 5 years, including *Banji*, *Ganzhousaurus*, *Jiangxisaurus*, *Nankangia*, and *Huanansaurus*.



Artist's rendering of *Tongtianlong limosus*, the muddy dragon on the road to heaven

And speaking of feathers, a group of paleontologists from the University of Akron has discovered a new Cretaceous bird fossil from the Jiufotang Formation in the Liaoning Province of China with remarkably preserved feathers. It belongs to the Bohaiornithidae, a family of Enantiornithes, a diverse group of birds that lived during the time of the dinosaurs. The fossil consists of a nearly complete skeleton with preserved colored feathers. Because the current knowledge base of prehistoric plumage is limited,

any new findings provide valuable insights related to structure and coloration in feathers. Many enantiornithine birds possessed ornate feathers, and the new fossil illustrates that some enantiornithines also had iridescent feathers. Unlike in most modern birds, such as flashy feathers developed

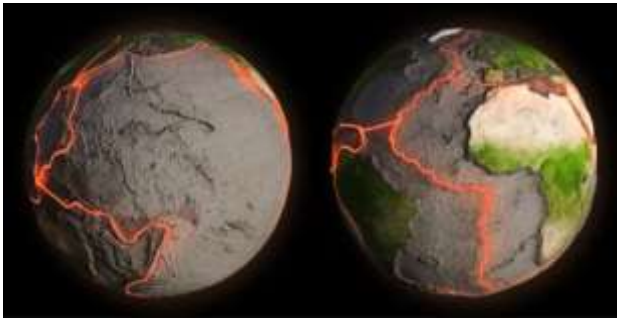


Skeleton of a new Cretaceous bird from China preserving iridescent feathers

before the animal was fully grown. The new specimen has a mixture of juvenile and subadult skeletal characteristics, while preserving feather morphologies indicative of sexual maturity. There are exceptionally-preserved feathers covering the body, including elongate crown feathers, body contour feathers, asymmetrically-veined wing primaries, and two elongate rachis-dominated rectrices that may have been sexual ornaments. In addition, the crown, neck, and body contour feathers retain morphologies associated with weakly iridescent coloration in the feathers of modern birds. The researchers believe the specimen represents the smallest, possibly the youngest, bohaiornithid bird ever found.

Researchers from Saint Louis University have new information about the kinds of geological conditions that can cause tectonic plates to sink. Plates are rigid and behave as units. Yet, most of the Earth's tectonic plates are moving because they are sinking into Earth like a towel laid down on a pool will start to sink and drag the rest of the towel down into the water. Plates move, on average, 1 or 2 in/yr, with the fastest plate moving about 4 in/yr and the slowest hardly moving at all. Besides causing earthquakes and volcanoes, plate movement affects our lives in other ways as well. For example: it was recently revealed that Australia is moving relatively quickly northwards and over many decades has traveled several feet,

causing GPS locations to be significantly misaligned. This has dictated that Australia needs to redraw its maps.



Some of the fault lines (red) between tectonic plates

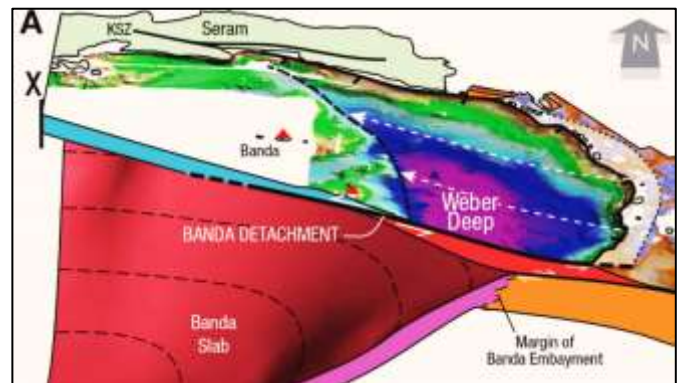
Subduction, the process by which tectonic plates sink into Earth's mantle, is a fundamental tectonic process on earth, and yet the question of where and how new subduction zones form remains a matter of debate. Subduction is the main reason tectonic plates move.

The research team traveled to the Philippines to study plates in that region. They found that a divergent plate boundary was forcefully and rapidly turned into a convergent boundary where one plate eventually began subducting. This surprised them because plate material at a divergent boundary is supposed to be buoyant and subduction resistant. The new research suggests that the buoyant (but weak) plate material at a divergent boundary can be forced to converge until older and denser plate material eventually enters the subduction zone, and the subduction becomes self-sustaining.

In particular, the studied subduction zone may have been forced to start because of the collision of India with Asia. When that happened, large chunks of Asia were pushed southeastward and perhaps triggered the start of a new subduction zone. Whenever scientists can show how something that is unexpected might have actually happened, it helps to paint a more accurate picture of how Earth behaves, and a more accurate picture of large-scale Earth processes can help us better understand earthquakes and volcanoes, as well as the origin and locations of mineral deposits, many of which are the effects and products of large-scale plate motions.

An international team of geologists from the Australian National University and Royal Holloway University of London has made the first ever reconstruction of the Banda Detachment Zone, in eastern Indonesia. Researchers found that a 4.3-mile (7 km) deep abyss beneath the Banda Sea off eastern Indonesia was formed by extension along what could be the largest exposed fault plane ever discovered on Earth.

The oceanic abyss known as the Weber Deep had been known for almost a century, but previous studies had not been able to determine exactly how it formed. By analyzing high-resolution maps of the Banda Sea floor, the scientific team found the rocks flooring the seas are cut by hundreds of straight parallel scars. These deformation features show that a piece of crust bigger than Belgium or Tasmania must have been ripped apart by 74.5 miles (120 km) of extension along a low-angle crack, or detachment fault, to form the present-day ocean-floor depression.



A cross-section through the Banda Detachment

This major fault had previously been hypothesized to exist based on bathymetric data and regional geology, but researchers had never before seen it. Rocks immediately below the fault include those brought up from the mantle. This demonstrates that extreme amounts of extension must have taken place to thin the normal oceanic crust above the mantle down to almost nothing.

The research on the Banda Detachment will help researchers assess dangers of future tsunamis in the area, which is part of the Ring of Fire – an area around the Pacific Ocean basin known for earthquakes and volcanic eruptions.

PGS Thanks Our Corporate Sponsors

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PGS Website of the Month



<http://climate.nasa.gov/>

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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 Tamra Schiappa, Program Chair at tamra.schiappa@sru.edu.

PGS Website: Access many online PGS resources at <http://www.pittsburghgeologicalsociety.org/>

Facebook: Follow the PGS at <https://www.facebook.com/PittsburghGeologicalSociety> for breaking news, announcements and interesting geological facts.

Twitter: PGS now has a Twitter Feed! You find it at <https://twitter.com/> on the web or look for [@PghGeoSociety](https://twitter.com/PghGeoSociety) on your mobile Twitter app.

LinkedIn: PGS has added a dedicated [LinkedIn page](#) to our social media portfolio. We'll use it to post job opportunities and other professional announcements for our members.



Fun Fact Having Nothing to Do with Geology

If you had enough US one dollar bills to build a stack one mile high, they would be worth \$14.5 million.