PITTSBURGH GEOLOGICAL SOCIETY

December 19, 2018

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

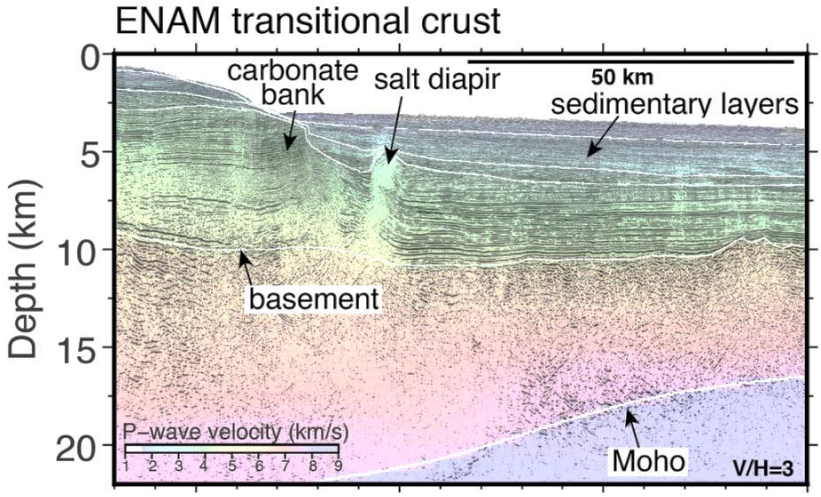
Dinner costs
$30.00 per person
$10.00 student member

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

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

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

A New View on the Deep Structure of the Eastern North American Margin: Implications for Continental Breakup and Early Seafloor Spreading History



Dr. Anne Bécel

Geo PRISMS — *Geodynamic Processes at Rifting and Subducting Margins*

2018 Geo-PRISMS National Lecturer

Associate Research Professor

Lamont - Doherty Earth Observatory
Columbia University

Deadline for reservations is noon on Monday, Dec 17.

Speaker Abstract

The Eastern North American Margin is a volcanic rifted margin that formed after the Mesozoic breakup of supercontinent Pangaea. In September-October 2014, the NSF-GeoPRISMS-funded East North American Margin (ENAM) Community Seismic Experiment (CSE) acquired active source seismic data on a 500 km wide section of this continental margin offshore North Carolina. One of the goals of this experiment is an improved understanding of events surrounding final stages of breakup including the relationship between the timing of rifting and the occurrence of offshore magmatism that gives rise to the East Coast Magnetic Anomaly and early seafloor spreading history of this passive margin that remain poorly understood. Because active-source seismic data acquisition extends farther offshore than previous seismic surveys conducted in and around this area to encompass the full transition to mature seafloor spreading including the enigmatic Blake Spur Magnetic anomaly (BSMA), the new seismic data from ENAM-CSE provide a new view on the formation of this margin.

In this lecture, I will present results from multichannel seismic data along two offshore margin normal profiles, spanning from continental crust ~50 km off the coast to mature oceanic crust and a profile along the Blake Spur Magnetic Anomaly. These three profiles are coincident with wide-angle reflection/refraction profiles. Seismic images reveal a major change in the basement roughness for the earliest oceanic crust formed at this margin, including a 1-km basement step-up at the BSMA on both margin normal profiles. Seaward of this anomaly, the basement is very smooth and reflective and clear Moho reflections are observed 8-10 km beneath the basement top. Landward of the BSMA, basement is very rough and typical of very-slow to slow spreading oceanic crust; the crustal thickness is thinner than normal oceanic crust and velocities in the lower crust are high. All these observations suggest that the domain landward of BSMA represents proto-oceanic crust formed above remaining continental lithosphere and that BSMA marks the location of the full rupture of the continental lithosphere and initiation of normal seafloor spreading.

Speaker Biography

Dr. Anne Bécel graduated with a B.S. in Physics-Geophysics from the University of Rennes I (France) and a M.S. and PhD in Geophysics from the Institut de Physique du Globe de Paris (IPGP; 2006). She was a Postdoctoral Scholar at the CSIC-Jaume Almera Institute in Barcelona (Spain) and Collège de France in Aix-en-Provence (France) before starting her Associate Research Scientist position at Lamont Doherty Earth Observatory of Columbia University in 2011. She is currently a Lamont Associate Research Professor. Her research focuses on characterizing the seismic structure of the Earth's crust and mantle to better understand underlying tectonic and magmatic processes primarily along active plate boundaries such as transform faults or subduction zones but also at rifted passive margins and ocean basin settings. To investigate these processes, she uses marine active-source seismology which can yield constraints on the formation and geometry of structures and faults, composition and other physical properties such as presence of fluids. Ultimately, she combines her information from active and passive source seismology with other geophysical imaging (bathymetry, drill hole, gravity and magnetic studies), geochemistry, constraints on active processes (GPS, InSAR, seismicity), and numerical modeling. Since she arrived at Lamont, her research has mainly focused on the study of the Alaska Peninsula and Hellenic subduction zones with an emphasis on assessing specific risks such as large earthquakes and associated tsunamis and the development of the Eastern North American passive margin.

Upcoming PGS Meeting

Next month's PGS Dinner Meeting will be held jointly with AEG and ASCE on January 16, 2019.

Drones: Providing New Perspectives for Geologic Research and Investigations

Martin F. Helmke PhD PG
Professor of Hydrology
West Chester University
PCPG President-Elect

For the past decade, the Pittsburgh Geological Society has held our monthly meetings at Foster's Restaurant in Building 10 of Foster Plaza. Unfortunately, due to a planned renovation that will begin in January, this facility will no longer be able to accommodate our monthly meetings.

We have begun the process of finding a new site, but in the meantime we are very grateful to **Cefalo's Banquet and Event Center** in Carnegie for being able to host our meetings on very short notice.

Please note the change in location of the January 2019 joint PGS-ASCE-AEG dinner meeting.

We will meet at Cefalo's in January and possibly for the remainder of the spring if the PGS board of directors decides that feedback from the members about the venue is encouraging.

It is important to note that this change in venue will **not** impact our December meeting, which will be the last one to take place in the usual facility in Foster Plaza.

PRESIDENT'S STATEMENT

As 2018 comes to a close, a reflection on the past year at PGS is in order. So much has happened in the last 12 months!

I became Interim President in January and then was elected to serve as President in May. I am honored to serve as President and enjoy working with a committed and experienced board. The Society finished off the 2017-2018 program year in June fiscally strong and with solid membership numbers. One highlight of the past year was the student drilling workshop, which was piloted as a 2-day workshop. The workshop was hosted at California University of Pennsylvania and started Friday evening with a career networking session and an introduction to drilling as a way to prepare students for the next field day. On Saturday, the students spent the day learning various field skills and assisting in core drilling. Students learned about the various field techniques and experienced the life of a field geologist. We plan on offering this 2-day workshop again in April to another sold-out crowd.

Several other items to look for in the next year are the establishment of a PGS Undergraduate Academic Scholarship and an official PGS Code of Conduct document. We hope to formalize a plan to offer a scholarship to a student member at the start of the new academic year. Students should keep an eye out for the announcement and application sometime in the spring. We will also publish a PGS Code of Conduct that serves as an internal guideline and external statement of the Society's values and commitments. In light of the #MeToo movement and as a reminder of the importance of civility, I am drafting a statement that articulates the values and principles of the Society with links to standards of professional conduct. Many other local and national societies have adopted a Code of Conduct and I felt that it was important for PGS to do this as well. I plan on submitting a draft to the Board at our December meeting and once the Board has provided comments, we will open it up for member comment.

Other big news is that this month's Society meeting will be our last one to be held at Foster's Restaurant. We will be meeting at Cefalo's Banquet Center in January as Foster's will be closed for remodeling. Our program this month is a bit out of the ordinary from the usual end-of-the-year travel log as our invited speaker is from the Geo-Prisms national lecture program. The Geo-Prisms program provides high caliber speakers that lecture to a broad audience on current information covering specific topics related to processes along the continental margin. This will be a great talk to stimulate our brains and to say farewell to Foster's Restaurant and 2018.

As we end the year, please remember that if you are considering a last minute charitable contribution, you can donate to the PGS Endowment or the Galey Fund for Students. Have a wonderful holiday, safe travels and I look forward to seeing you in the New Year at our new location in January.

Happy holidays!

Tamra

LOCAL GEOLOGICAL EVENTS

ASCE GEO-INSTITUTE OF PITTSBURGH

December 4, 2018
The Development and Advancement of Ground Improvement" by Dave Sandstrom, Menard Group US

Engineers' Society of Western Pennsylvania, Pittsburgh PA

GEOPHYSICAL SOCIETY OF PITTSBURGH - PITTSBURGH ASSOCIATION OF PETROLEUM GEOLOGISTS – SOCIETY OF PETROLEUM ENGINEERS

December 12, 2018
Joint GSP-PAPG-SPE Christmas Party

Cefalo's Banquet & Event Center, Carnegie PA

AMERICAN SOCIETY OF CIVIL ENGINEERS - PITTSBURGH

December 12, 2018
"Planning for Success in an Uncertain Future" by Dr. Eric Merriam, US Army Corps of Engineers Climate Change Program

Engineers' Society of Western Pennsylvania, Pittsburgh PA

The Pittsburgh Geological Society welcomes the following new student member:

Devon J. Miller, Slippery Rock Univ. of PA

THE PITTSBURGH GEOLOGICAL SOCIETY ENDOWMENT FUND

Established May 8th, 2014 through the

COMMUNITY FOUNDATION
Serving the Heart of Western Pennsylvania

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 at 220 South Jefferson Street, Suite B, Kittanning, PA 16201. For more information please contact Ray Follador, PGS Finance Committee Chair at (724) 744-0399 or Jodi Beers, Executive Director of the Community Foundation at (724) 548-1261 or jodi@servingtheheart.org.

THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES

The iconic Evans City Cemetery, where part of *Night of the Living Dead* was filmed in 1968.

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Robert Boggs, one of the earliest pioneers in Butler County, settled on a 400-acre tract of land along Breakneck Creek in 1796. Forty-three years earlier, George Washington had walked and ridden by horseback through the area along trails used by the Native Americans to travel between what are now Pittsburgh and Franklin, and between Economy and Prospect. Since trails existed, they eventually became roads for other settlers to travel, and Boggs opened a tavern and erected a grist mill.

In 1836, Thomas B. Evans bought the mill and 200 acres from Boggs and two years later laid out a village that he called Evansburg. The name later became Evans City. The post office at that time was called Breakneck. Since Breakneck was not located on a postal road, mail from Pittsburgh was left at Zelienople and taken on a weekly basis by a government contractor to Breakneck Post Office until 1879 when the Pittsburgh and Western Railroad was completed, giving the town a direct connection with Pittsburgh. The railroad not only brought the mail, it also brought people and prosperity.

Evans City was finally incorporated as a borough in 1882. In 1903, a railroad station was built spanning Breakneck Creek, which flowed 14 feet below. Cupolas on each end gave watchmen a view in both directions. Despite protests by local citizens, the station was torn down in 1977, but Ripley's "Believe It Or Not" recognized it as the only railroad station built completely over water. Evans City had a short-lived oil boom in 1915-17, but despite the fact that it lasted only two years, it created so much excitement and wealth that the town became known as the "City of Black Gold". Today, Evans City is probably best known as the location where the 1968 cult horror film *Night of the Living Dead* was filmed.

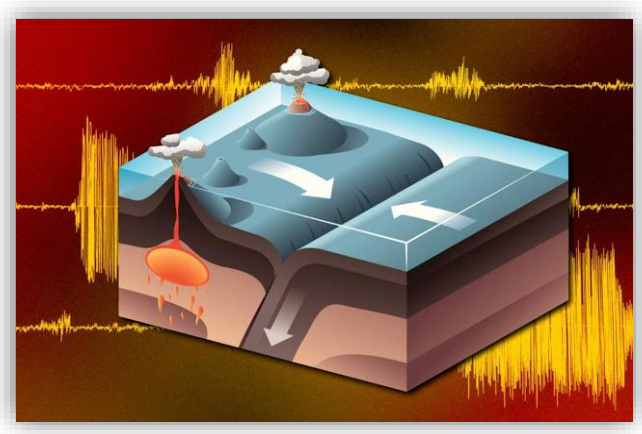
DID YOU KNOW . . . ?

Scientists have diagnosed the Earth with a bizarre geological condition known as “stagnant slabs,” a condition in which rock material subducted into the mantle becomes wedged hundreds of miles below the surface. The existence of “stagnant slabs” became known only about a decade ago. A team of geoscientists recently explored the physics of "stagnant slabs," which form when huge chunks of oceanic plates are forced deep beneath the edges of certain continental plates.

Although the chunks will sink into the mantle for hundreds of miles, they inexplicably stop moving, like a car that has stalled. Now, the research team thinks they might have found the reason for this phenomenon. By using computer simulations, they were able to examine a series of “stagnant slabs” near Japan and the Philippines and discover that the “cold” rocks seemed to be sliding on a thin layer of weak material at the boundary of the upper and lower mantle about 410 miles deep.

The team speculated that the stoppage is probably temporary, a fairly recent phenomenon that probably occurred in the last 20 million years. Their existence suggests that the mantle convection system may actually slow down or even stop in

some areas. If so, it would probably affect other Earth features, such as East Asia's roiling volcanos.



Cartoon of the Earth's interior. Scientists are exploring why subduction of oceanic crust has stalled in certain areas of the world.

Most of these "stagnant slabs" are known from the western Pacific Ocean, specifically off the east coast of Japan, in the Mariana Trench, and other subduction zones. In contrast, subducted slabs at other sites near North and South America behave in expected ways – they dive through the upper mantle and into the lower mantle where they heat up near the core. Around Asia, however, they stop moving downward. They spread out horizontally near the boundary between the upper and lower mantle, instead, the zone where heat and pressure inside Earth cause minerals to change phase.

The researchers found that the only way they could explain the behavior of the "stagnant slabs" was if a thin layer of less-viscous rock was somehow wedged in between the two mantle layers. Although no one has ever directly observed such a layer, geoscientists have predicted that it exists by studying the effects of heat and pressure on rock. If it does exist, it would act like a layer of grease in the middle of the mantle. Such a weak layer at that depth would reduce the viscosity, thereby helping to lubricate the region. The slabs would get deflected at the layer and move horizontally for long distances.

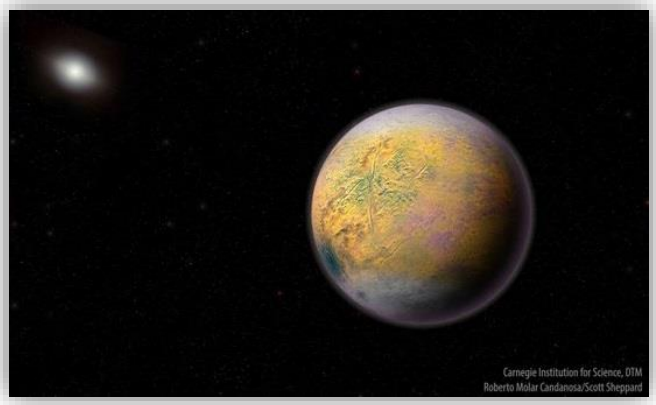
So why do "stagnant slabs" occur off the coast of Asia, but not the Americas? The research team thinks it's because the movement of the continental plates above gives the slabs more room to slide. But, they conjecture, with enough time, they should break through the "greasy" part of the mantle and continue their plunge toward the planet's core.

http://www.geologyin.com/2018/10/a-wrench-in-earths-engine-stagnant-slabs.html

Scientists have discovered another bit of evidence for Planet Nine in our solar system (also called Planet X). They spotted 2015 TG387 in October 2015 using the 26-foot telescope atop Mauna Kea in Hawaii, and nicknamed it "The Goblin" because of the discovery date and the "TG" in the provisional designation.

The Goblin is a newfound object in the far outer solar system, lying way beyond the orbit of Pluto. Its orbit shares peculiarities with those of other far-out bodies, those that seem to have been shaped by the gravity of a very large object that is very distant, in the frigid area at the distal part of the solar system. The more distant objects like The Goblin astronomers can find, the more clues they will have to lead them to Planet X, if it exists. The actual discovery of such a planet would redefine our knowledge of the solar system's evolution.

Astronomers estimate that The Goblin is about 186 miles in diameter, and since it is probably spherical, it would qualify as a dwarf planet. The Goblin shares "low-bias" classification with two other dwarf planets: 2012 VP113, which astronomers spotted in 2014; and the relatively



Artist's depiction of a large undiscovered planet in the outer solar system that might be shaping the orbits of smaller objects, such as the newfound dwarf planet 2015 TG387, dubbed "The Goblin."

bright Sedna. In fact, the existence of Planet X was first seriously proposed in 2014 to help explain oddities in the orbits of 2012 VP113, Sedna, and a few other far-out objects.

After The Goblin's discovery, the team needed three additional years to confirm its orbit. It loops around the sun on an extremely elliptical path, coming within about 65 astronomical units (AU) of the sun at perihelion and getting about 2,300 AU away at aphelion. In contrast, Earth's orbit is just shy of one AU at perihelion and just slightly more than one AU at aphelion. One AU is equal to 92.96 million miles, so The Goblin's orbit brings it to about 604.2 million miles from the sun at its closest point. So far as is known, only 2012 VP113 and Sedna have more-distant perihelia than The Goblin, and only one, known as 2014 FE72, is farther out at aphelion.

In 2016, another team of astronomers presented additional evidence for Planet X (they called it Planet Nine) and suggested that it may be about 10 times more massive than Earth and orbit about 600 AU from the sun on average. The odds that Planet X exists are around 85%. But it isn't surprising that no one has seen any direct evidence of it. Anything even as large as Neptune that is hundreds of AUs from Earth would be so faint that most telescopes would not be able to detect it. You could hide something very large in the outer solar system very easily.

https://www.scientificamerican.com/article/newfound-world-the-goblin-may-lead-to-mysterious-planet-nine/

A team of scientists from China, the US, and Canada used new high-resolution radiometric dating, detailed biostratigraphy, and geochemical analyses to determine that the Permian-Triassic extinction event occurred in less than 30,000 years. Earth's greatest mass extinction, known as the "Great Dying," occurred about 252 ma. More than 90% of marine life and most land species went extinct at that time. Even usually resilient plants and insects nearly went extinct.

What could have caused it? The research team's efforts resulted in evidence showing the end-Permian extinction to have occurred essentially instantaneously by geological standards. It might have occurred in only thousands of years, but analytical uncertainty of current dating techniques prevented the team from getting a more meaningful constraint for less than 30,000 years. The study also seemed to confirm the extinction might have been caused by the Siberian Traps flood-basalt eruptions, along with local intensive explosive volcanism that might have started about 420 ma before the extinction event. Such events could have reduced the stability of Late Permian ecosystems significantly, to the point where a single extreme incident would have resulted in a sudden ecosystem collapse.

Photo of the Permian-Triassic boundary interval in outcrop at Penglaitan in the Guangxi Region of South China.

Scientists have spent years studying the Permian-Triassic boundary at Meishan in Zhejiang Province, South China, which acts as the international reference for the boundary. It is, however, a condensed section, a lot of time represented by a small thickness of sediments, that has made it difficult to determine if the extinction event was abrupt or gradual. The new research looked instead at the Penglaitan section in South China's Guangxi Autonomous Region. Those sediments deposited in shallow, tropical waters where they accumulated more than 100 times faster than in the Meishan beds. The Penglaitan section, therefore, became much thicker during a comparable period of time,

allowing the scientists to study the events at the Permian-Triassic boundary at a much higher temporal resolution.

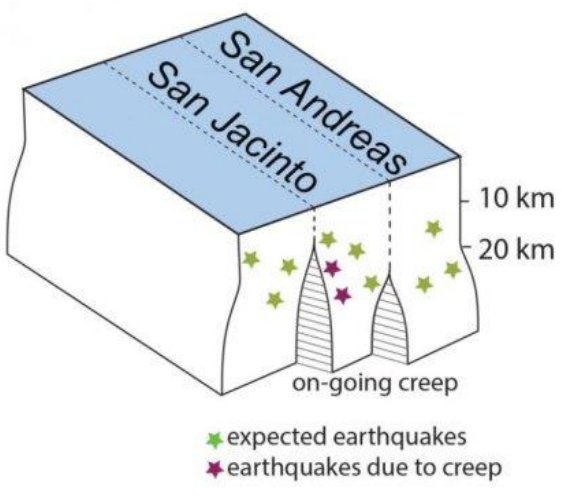
The Penglaitan section also has better geochronologic and stratigraphic controls, as well as rich paleontological data, enabling examination of the fine structure of the extinction and coeval environmental perturbations. The Penglaitan section had a rich Late Permian biota consisting of, at least, brachiopods, ammonoids, sponges, corals, conodonts, foraminifera, bryozoans, bivalves, and trilobites. Of 66 species identified in the Permian portion of the section 29 disappeared within or at the top of a single bed of volcanic ash-rich sandstone, and none extended into the Early Triassic. The entire marine ecosystem suddenly disappeared during the time of deposition of that single bed.
The Siberian Traps have radiometric ages that match the radiometric dates recovered from the volcanic ash beds preserved at both Penglaitan and Meishan, suggesting a direct connection. Volcanic gases such as CO_2, CH_4, and SO_2 could have been deadly. Added to that, lethal greenhouse warming, oceans depleted of dissolved O_2, acid rain, and atmospheric heavy-metal pollution would have made life very difficult.

Previous studies could not determine if there were only one or as many as two pulses of extinction at the boundary. Paleontologists could not determine whether some Permian species might have survived into the Early Triassic. Now, the Permian deposits at Penglaitan, which contain more than 50 volcanic ash layers and volcanic ash-rich sandstone beds, possibly produced by pyroclastic flows from the nearby volcanic arc eruption centers in South China, present a much clearer picture of the extinction episode. The abrupt change in deposition from the uppermost Permian limestones and ash-rich sandstones to black shale with centimeter-scale limestone interbeds in the lowermost Triassic clearly represents a major shift in the oceanic environment. High-resolution paleotemperature measurements across the mass extinction interval suggest a substantial warming of up to 10°C (50°F) immediately after the mass extinction event, which could explain a shift in sediment type from limestones in the Permian to black shales in the Early Triassic, indicating ocean anoxia.

Warming climate could have caused ocean currents to become sluggish at the same time increased weathering and river runoff brought increased nutrients into the sea. The reduction in mixing of oxygen-rich waters from the ocean surface with deeper waters, and the increase in ocean productivity triggered by the increased nutrient supply, could have led to increased organic carbon deposition and resulting ocean anoxia.

https://www.eurekalert.org/pub_releases/2018-09/caos-cts091718.php

Geoscientists at the University of Massachusetts at Amherst used a new analysis of numerous small earthquakes that have occurred in the San Bernardino basin near the San Andreas and San Jacinto faults to suggest that some unusual deformation in the area be due to "deep creep" 6 miles below the Earth's surface. Seismic stations have been recording the style of deformation for thousands of small earthquakes in California's San Bernardino basin since 1982 and the researchers found the data very useful in their study. Until now, seismologists have been assuming that the regional faults are locked, and that no creep is taking place. They have been using data from all the little earthquakes to infer loading on the primary faults.



Cartoon showing how anomalous earthquakes near the San Andreas and San Jacinto faults work in regions deep below the Earth's surface.

It turns out that many of the earthquakes were caused by faults that move in a different way than most of those in the region. The typical fault type in the region is strike-slip. Less common, with "anomalous slip-sense," are the extending faults, where one block drops at an angle away from the other, thereby “extending" the fault. This enigmatic behavior occurs in about 1/3 of hundreds of tiny quakes recorded during the lull between big damaging quakes, and their possible significance had not been appreciated previously. They only occur in this one small area, but nobody knew why until the UM geoscientists did the modeling. They began with a hypothesis based on earlier 3D modeling in the area that had replicated long-term deformation over thousands of years. Unlike the surrounding regions of strike-slip, the basin was in extension in earlier models, with extension limited to within the basin just like the pattern of the anomalous extensional earthquakes.

These data gave the researchers a clue that maybe those faults weren't locked as they should be between big earthquakes, but that at depths below 6 miles, they were creeping. Typically, they would have looked for creep using GPS stations set up on either side of the fault. In this area, however, the San Andreas and San Jacinto faults are so close together that the GPS is unable to resolve whether there is creep or not. Therefore, no one had been able to see it previously. Their report showed that it is possible to have tiny earthquakes occurring constantly next to the San Jacinto Fault below 6 miles, where deep creep may be happening. It is not only plausible but can also account for nearby enigmatic earthquakes.

This work has implications for assessing fault loading. It demonstrates that small earthquakes that occur adjacent to and between faults can have very different style of deformation than the large ground rupturing earthquakes produced along active faults. Therefore, scientists should not use the information recorded by these small earthquakes in the San Bernardino basin to predict loading of the nearby San Andreas and San Jacinto faults. The researchers admit that the model may not be perfectly correct, but it's consistent with observations. This research should support more refined assessments of fault loading and earthquake-rupture risk in the region.

https://www.sciencedaily.com/releases/2018/09/180918131713.htm

A nearly 130-million-year-old fossilized skull found in Cretaceous rocks of eastern Utah has become an Earth-shattering discover. The small fossil is evidence that Pangea continued to split up more recently than scientists had previously thought, and that a group of reptile-like mammals that span the reptile-mammal transition experienced an unsuspected burst of evolution across several continents.

Possible reconstruction of *Cifelliodon wahkarmoosuch*, a newly discovered Cretaceous mammal.

Scientists at the University of Southern California, the Utah Geological Survey, and the University of Chicago studied the nearly complete fossilized cranium, which they named *Cifelliodon wahkarmoosuch* (the species name means "yellow cat" in the Ute tribe's language in respect of the area where it was found), using high-resolution computed tomography (CT) scanners to analyze the skull. They now recognize a new, cosmopolitan group of early mammal relatives and updates the understanding of how mammals evolved and dispersed across major continents during the Mesozoic. Among other things, their research suggests that the breakup of Pangea continued for about 15 ma later than previously thought, and that the migration of mammals and their close relatives continued during the Early Cretaceous 145 to 101 ma.

Paleontologists used to think early mammals from the Cretaceous were anatomically similar and not ecologically diverse. This new fossil, however, reinforces that, even before the rise of modern mammals, ancient relatives of mammals were exploring specialty niches such as insectivory, herbivory, carnivory, swimming, and gliding. In other words, they were occupying the variety of niches we see them occupying today. The study indicates that the early mammal precursors migrated from Asia to Europe, then into North America and onto the major Southern continents.

The complete animal would have weighed about 2.5 pounds, small compared to many living mammals, but it was a giant among its Cretaceous contemporaries. It had teeth that could nip, shear and crush, similar to fruit-eating bats, so it might have incorporated plants into its diet. It had a relatively small brain, giant "olfactory bulbs" to process sense of smell, and poor eyesight suggested by tiny eye sockets. It was probably nocturnal and depended on smell to find food.

The researchers place *Cifelliodon* within the clade Haramiyida, an extinct branch of mammal ancestors related to true mammals. It was the first of the family Hahnodontidae found in North America. Discovery of *Cifelliodon* emphasizes that haramiyidans and some other vertebrate groups existed globally during the Jurassic-Cretaceous transition, meaning the corridors for migration via Pangean landmasses remained intact into the Early Cretaceous. Most of the known haramiyidans are from the Triassic and Jurassic of Europe, Greenland, and Asia; the family previously was known from the Cretaceous only in Northern Africa, providing evidence of migration routes between the continents that are now separated in northern and southern hemispheres.

https://www.sciencedaily.com/releases/2018/05/180523133203.htm

All large-scale energy systems have environmental impacts. The ability to compare the impacts of renewable energy sources is an important step in planning a future without fossil fuels. Generating energy by wind power causes climatic impacts, but they are small compared to current projections of 21st-century warming. Still, they are large compared to the effect of reducing US electricity emissions to zero using solar energy.

New research out of Harvard reports the most accurate modelling yet of how increasing wind power would affect climate – large-scale wind power generation would warm the continental US 0.24ºC (32.4ºF) because wind turbines redistribute heat in the atmosphere. Although wind is environmentally friendly in comparison to coal by any measure, that doesn't mean that its impacts are negligible. If we are to transition away from fossil fuels to stop carbon emissions quickly, we will have to make choices between various low-carbon technologies, all of which have some social and environmental impacts.

Wind farm in the Appalachian Mountains of Pennsylvania operated by Green Mountain Energy.

While wind turbines generate electricity, they also alter atmospheric flow, which then redistribute heat and moisture in the atmosphere, thereby impacting climate. The researchers attempted to compare wind and solar energy by modelling their effects on a continental scale. First, they established a baseline for the US climate in 2012-2014 using a standard weather forecasting model. Then they added in the effect on the atmosphere if we covered 1/3 of the continental US with enough wind turbines to meet present-day US electricity demand, a relevant scenario if wind power becomes a major player in decarbonizing the energy system later in the 21st century. In this scenario, the the surface temperature of the continental US would rise by 0.24ºC (32.4ºF). They also found it would take about a 100 years to offset that effect with wind-related reductions in greenhouse gas concentrations. The direct

climate impacts of wind power are instantaneous whereas the benefits accumulate slowly.

Wind power actually has more climate impact than coal or gas over a 10-year period, but over 1000 years it is enormously cleaner than fossil fuels. They also compared the impact of wind power to previous projections of the influence of solar power on the climate. For the same amount of energy generation, the environmental impact of solar power would be about 10 times smaller than wind.

Both sources of energy have their good and bad points, of course. In terms of atmospheric temperature difference per unit of energy generated, solar power has about 10 times less impact than wind, but solar farms typically are dense. In contrast, the land between wind turbines can be used for agriculture. The study did not do simulations that consider any impacts on global-scale meteorology, how large-scale wind farms would affect the climate the climate in other countries is uncertain. Some climate impacts of wind energy might may be beneficial, so the work should be seen as a first step in getting more serious about assessing these impacts.

https://www.sciencedaily.com/releases/2018/10/181004112553.htm

If you are a normal, relatively intelligent person, you probably picture the Earth as a ball spinning through space. To one of the folks who recently gathered at a park in Arcadia, California, however, you would be wrong! To them, Earth is actually "flatter than a pancake." Those folks are the Flat Earthers (shades of Terry Pratchett's Discworld series of hilarious and snarky "sci-fi" novels!!!). They insist the Earth is flat, that we're living on a disk floating through space, with a tiny sun hovering just overhead.

Earth's curvature doesn't exist, they say, because, according to them, no one's ever seen it. According to their philosophy, the perimeter of our Flat Earth is a wall of ice that holds in the ocean and everything else. And since no one has dug deeply into the Earth, no one knows what's down underneath. The Earth can't be spinning through space at 1,000 miles per hour or we'd feel it.

Flat Earthers have taken carpenter's levels onto airplanes to prove they are flying level, and they've zoomed in on the moon and supposedly seen what they believe are clouds drifting behind it (the moon is only a few miles above the flat earth). The sun is not 93 million miles away, nor is the moon 238.9 thousand miles away. In fact, they are probably about the same size.

According to these folks, photos of the Earth taken from space are completely and utterly false, and pictures of astronauts floating around on the space station are fake; they use harnesses and wires. No one has ever been to the moon, there are no rovers on Mars, and there has never been a fly-by of Pluto. In fact, we've never been to space. They believe NASA is just part of a broad conspiracy. Flat Earthers, in fact, don't believe anything unless they see it for themselves. One Flat Earther says they're not idiots, no matter what others might think and likens life to a giant game of chess with humanity as the pawns.

In Terry Pratchett's wonderful Discworld series, the world is a flat disc riding on four elephants riding on a giant turtle.

If this seems hilarious to you, there are others who are taking it seriously. A national security expert at Harvard thinks something new is happening, that people have really become obsessed with the idea that, if it's not part of their direct experience, it can't be true. Many people have lost faith in experts, developing a kind of reverse snobbery that says if you have a great deal of education, if you're at a well-known institution, by definition you must be a liar! Sometimes younger people think the internet is just a big library when in fact it is a big dumpster.

There's no guarantee that anything you find on it is true (the Flat Earth movement mostly orbits around YouTube!). When told the internet is more democratic, this expert's reply is that when it comes to knowledge, more democratic is not good. For example, we don't decide how fast things accelerate in a vacuum by voting on it.

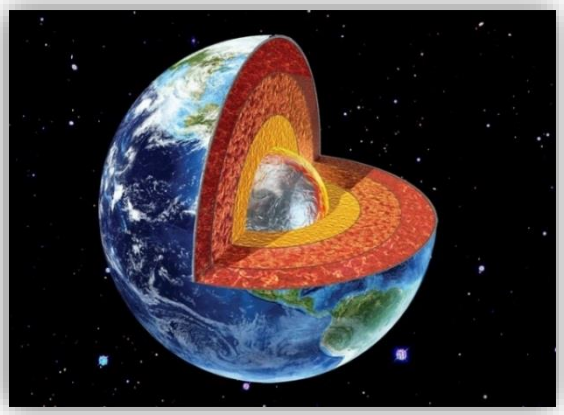
So, what are the Flat Earthers doing? One of them, named Mad Mike, built a steam-powered rocket and flew it to 1,800 feet to see what he could see (amazingly, he took flight and landed intact, more or less). But 1,800 feet is not high enough to properly survey the planet so Mad Mike plans to fly 62 miles up to the edge of space, where he'll be able to see whether or not the Earth curves. He is seriously hoping to disprove centuries of science once and for all by observing an expected flat disk.

At least Mad Mike is honest. He says if he sees a round Earth, he'll tell everyone he was wrong. But we already know the Earth is round. And if you don't believe it, you'll discover it the hard way if you try and fly an airplane!

https://www.cbsnews.com/amp/news/the-flat-earth-movement-a-society-of-disbelievers-in-scientific-fact/

A new study by researchers at the Australian National University used a way to detect shear waves, or "J waves" in Earth's inner core (J waves are a type of seismic wave that can only travel through solid objects). Inner core shear waves are so tiny and feeble they can't be observed directly. Detecting J waves them has been a long-sought part of global seismology since scientists first predicted the inner core was solid in the 1930s and 40s. Detecting them, and determining the physical state of the core, is important because if we can confidently understand the inner core we can understand how the planet formed and continues to evolve.

The study found the inner core is solid, but also found that it is softer than previously thought. If the researchers' results are correct, the inner core shares some similar elastic properties with gold and platinum. But because of the difficulty with J waves, the researchers had to come up with a creative approach in dealing with them. They devised a "correlation wavefield method" that looks at the similarities between the signals at two receivers after a major earthquake, rather than at the arrivals of direct wave.



The Earth sliced open to reveal the inner and outer mantle and inner and outer core.

The researchers used a similar technique to measure the thickness of the ice in Antarctica. Rather than studying the onset of seismic waves on the seismogram, they "threw away" the first three hours and looked instead at the interval between three and 10 hours after a large earthquake strikes in order to eliminate the big signals. They used a global network of seismic station, taking every single receiver pair and every single large earthquake, and did a cross correlation by measuring the similarities between the seismograms. They then constructed a global "correlogram" from the similarities.

The study showed that the results could be used to demonstrate the existence of J waves and infer the shear wave speed in the inner core. Although the researchers couldn't determine the exact temperature of the inner core, what the age of the inner core is, or how quickly it solidifies, the new advances in global seismology are helping them get there. The understanding of the Earth's inner core has consequences for the generation and maintenance of the geomagnetic field, without which there would be no life on the Earth's surface.

https://phys.org/news/2018-10-earth-core-solid.amp

Even the extreme weather we've been experiencing for the last few years has not been enough to convince climate change sceptics that the global climate is warming, or that humans are at least partly to blame. Now research suggests that political bias and partisan news reporting have been influencing whether people actually think they have been experiencing certain extreme weather events. Even some Americans living in areas experiencing a variety of extreme events flood, tornado, hurricane, AND drought) could not be convinced the climate has been changing.

The research, by scientists in the UK and US, indicated that extreme weather plays a limited long-term role in forming people's beliefs about climate change. Their views and beliefs can alter the way they perceive the weather. Gray areas tend to make people apply a preferred label, rather than face up to facts. It's just more comfortable for them that way. For example, if an extreme weather event such as a polar vortex is ambiguous, people are more likely to see the event through partisan eyes. Thus, those with conservative leanings are less likely to report experiencing a polar vortex, whereas those with liberal leanings are more likely to accept it.

October 2018 satellite image of Hurricane Michael, a category 4+ storm, approaching the Florida panhandle.

When the weather actually is extreme, however, it overshadows personal views. The researchers found that partisanship and the media did not affect the way people in the northeastern US reported the weather they had experienced after the 2014 and 2015 polar vortex events where they hit hardest. Very extreme weather accompanied by constant media coverage is harder for people to deny. On the other end of the scale, though, droughts can take longer to have an effect, so people sometimes have difficulty perceiving their onset. This, in turn, might allow them to see the event in a biased way.

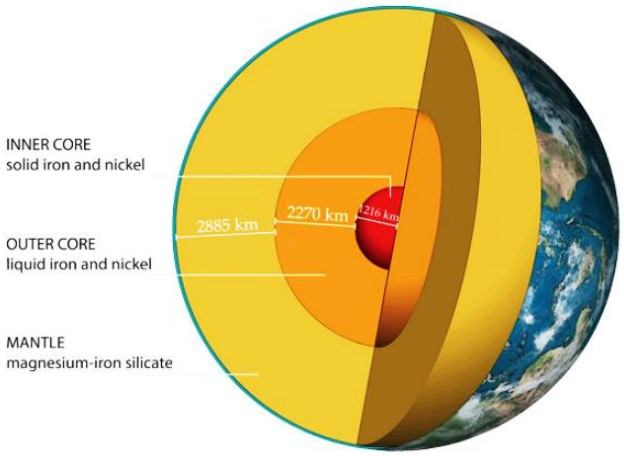
The researchers surveyed more than 3,000 people in the US, asking them where they lived, what extreme weather they had experienced over a five-year period, and if they believed in climate change, human causation, and the scientific consensus on the matter. They were then able to compare the answers to official weather reports for those regions and for the five-year period. Data included droughts, floods, tornadoes, and hurricanes. Of the respondents, 21.7% reported experiencing a polar vortex, 41.0% drought, 19.8 % a tornado, 29.3 % a flood, and 16.7% a hurricane at some point in that period. The weather data, on the other hand, showed 21.3% lived where a flood had been recorded, 25.3% a tornado, 4.3% a hurricane, and 4.4% drought. A majority, 59.2% agreed that there is solid evidence that the average temperature on earth has been rising over the past few decades. Of respondents who agreed with this statement, 74.2% agreed that the Earth was warming mostly due to human activity.

Efforts to connect extreme events with climate change may do more to rally those with liberal beliefs than convince those with more conservative views that humans are having an impact on the climate. The researchers concluded that we should take a look at the big picture rather than focusing on specific events. Especially intense events such as a 100-year flood or a catastrophic hurricane, might have the most influence on changing attitudes.

https://www.sciencedaily.com/releases/2018/10/181001171149.htm

PGS WEBSITE OF THE MONTH

https://www.bgs.ac.uk/discoveringGeology/hazards/earthquakes/structureOfEarth.html



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Fun Fact Having Nothing to Do with Geology

"Jingle Bells" is, of course, an iconic Christmas song. Wouldja believe it was written originally for Thanksgiving?

Also – this year, 2018, is the bicentennial of the first science fiction novel, Mary Shelly's immortal classic, Frankenstein (I just thought you needed to know that!).

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