PGS Newsletter

http://www.pittsburghgeologicalsociety.org/

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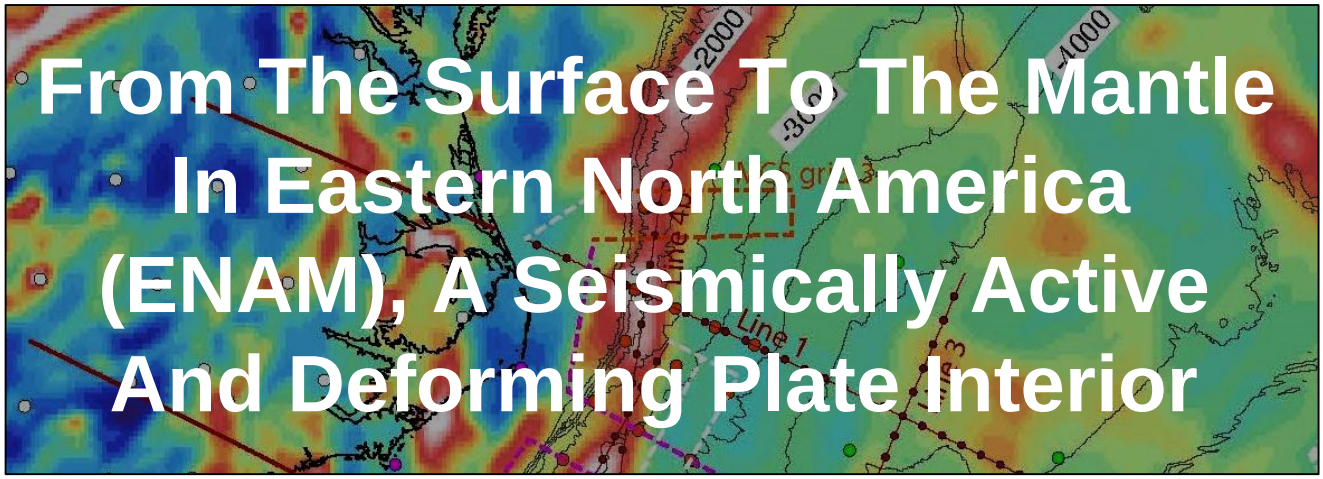
Wednesday, November 16, 2016



From The Surface To The Mantle In Eastern North America (ENAM), A Seismically Active And Deforming Plate Interior

Dr. Frank J. Pazzaglia

Department of Earth and Environmental Sciences
Lehigh University

Unlike plate boundaries, plate interiors lack a systems-level model that integrates the geologic, geodynamic, seismologic, and geomorphologic processes that collectively shape topography. Eastern North America (ENAM) lies in a plate interior where recent seismologic and geomorphic experiments, along with studies of a modest-sized earthquake, are being synthesized into a novel geodynamic model that explains the stress field and makes testable predictions of crustal deformation. Here there is a history of large (M 7), infrequent, and clustered earthquakes. In the context of this seismicity, paleogeodetic geomorphic markers and topographic metrics provide a rare opportunity to quantify the crustal deformation rate and test it against model predictions.

(Dr. Pazzaglia's abstract continues on page 2)

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, November 14.

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

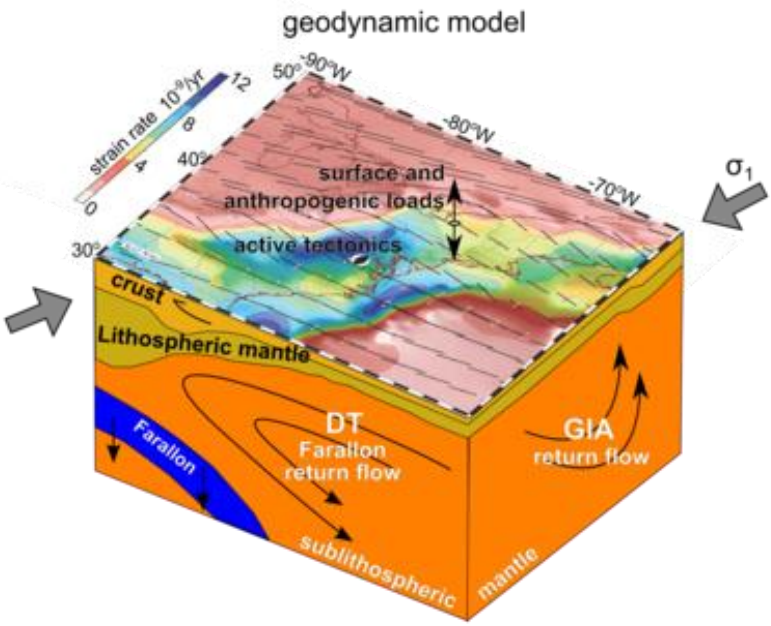
SPEAKER BIOGRAPHY

Dr. Frank Pazzaglia studies fluvial geomorphology and active tectonics, with applications to the Appalachians, Cascadia, Rockies, Crete, and the Apennines. He received his Bachelor of Science in 1986 from the Pennsylvania State University and his Master of Science in 1989 from the University of New Mexico. His doctoral research was done at Pennsylvania State University under Professor. T.W. Gardner, looking at tectonic geomorphology and late Cenozoic geology of the middle U.S. Atlantic passive margin. Dr. Pazzaglia began teaching at Lehigh in 1999 and served as chair of the department for several years. He is a member of the American Geophysical Union, the Geological Society of America, and the New Mexico Geological Society.

Abstract (continued)

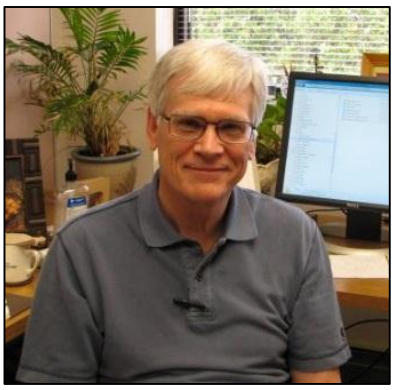
The epicenter region of the 2011 M 5.8 Mineral, Virginia, earthquake, an event that shares much in common with the 2012 Mirandola earthquake, is traversed by the South Anna River. A stratigraphic model of river terraces using optically stimulated luminescence (OSL), infrared stimulated luminescence (IRSL), and terrestrial cosmogenic nuclide (TCN) geochronology demonstrates that the long term incision rate in the uplifting hanging wall of the fault is approximately double the incision rate in the subsiding footwall. The terraces are arched up and over the surface projection of the fault plane that has been modeled to have generated ~7 cm of surface deformation distributed over a wavelength consistent with the deformed terraces. Spectral analysis of river channel planimetric form here and more broadly in ENAM indicate that the sinuosity of seismic zones is distinct from aseismic areas, providing a paleogeodetic metric sensitive to subtle crustal deformation.

With ideas ranging from glacial isostatic adjustment (GIA), to ridge-push effects, to lithospheric foundering, and sub-lithospheric mantle convection there is little consensus on the more regional geodynamic processes that build the crustal stresses leading to these earthquakes and surface deformation. Here, I present a self-consistent global model of the dynamics of ENAM that takes the first step in explaining the ENAM stress field. The model includes the effects of topography, lithospheric structure including crustal thickness, and coupling with density-buoyancy driven mantle flow.



A new crustal thickness map, generated by strong P to S conversions from 103 USArray TA and permanent stations, shows a steep gradient beneath the Appalachian Piedmont, largely coincident with seismicity, where the crust thickens from ~30 to 40 km. The model is particularly sensitive to these changes in lithospheric structure and suggests that ENAM seismicity and crustal deformation arises from a combination of lithosphere topography and structure, coupled with the effects of density-driven mantle flow. Maximum predicted shortening rates approaching ~0.5 mm/yr across the Piedmont and Coastal Plane regions underscore the real, but poorly understood seismic hazards that can exist for plate interiors like ENAM.

PRESIDENT'S STATEMENT



Many years ago my wife and I finally succumbed to the onslaught of electronic social media when we purchased a couple of flip cell phones. We did it for only one reason: to facilitate finding each other in the shopping mall. Years later I sent my first text message to my daughter (laboriously—pushed the "2" key three times to make a "c" etc.). She replied by welcoming me into the 21st century—sort of. If you haven't picked it up by now I confess I've long been one of those dinosaurs who adapted to the computer world only when he absolutely had to and looked at the technology as just a tool, regarding it with no more esteem than he would a hammer. Fortunately, some, most, or all other members of the PGS Board of Directors have a far more enlightened outlook on the electronic world, to PGS's great benefit.

One of those heroes is Diane Miller, one of our new Director's at Large and member of the Communications Committee. She set up the PGS Twitter account this past June as another means of communication among the PGS members. We currently have 20 followers and are following 29 other accounts that are related to geology, general science, Pittsburgh, and Pennsylvania. The Twitter profile has links to both the PGS website and Facebook page. Diane is a Senior Geologist for a consulting company and despite the workload she creates enough time to search for one or two interesting topics to tweet or re-tweet each day. She also tweets about PGS news and tries to post pictures from the PGS meetings. If you want to add yourself to the list of followers you can find them on twitter at @PghGeoSociety or on a web browser at https://twitter.com/PghGeoSociety. Just writing this is motivating me to do just that!

Erica Long, our Chairperson of the Communications Committee, has been doing a superb job operating and maintaining our Facebook account. PGS has been on Facebook since November 2009 which has been a way to interact with a wider audience as well as to keep in touch with our student members and those that have left the area. PGS has over 400 likes on Facebook (people who enjoy what we posted). We use this site to promote our meetings and field trips, share announcements or interesting articles from PGS as well as our sister societies and other geology related organizations. We all love a good geology joke so those get shared with the followers as well. We currently have 325 people in the Unites States following our posts and about 50 people from outside the US, including Mexico, Australia, Europe, and the Middle East. In addition, it's another way people can ask geologists about rocks and minerals they are finding in their back yard, or any other geology questions. PGS reaches about 300 people with each post. We encourage people to post pictures of their field trips or other geology-related items.

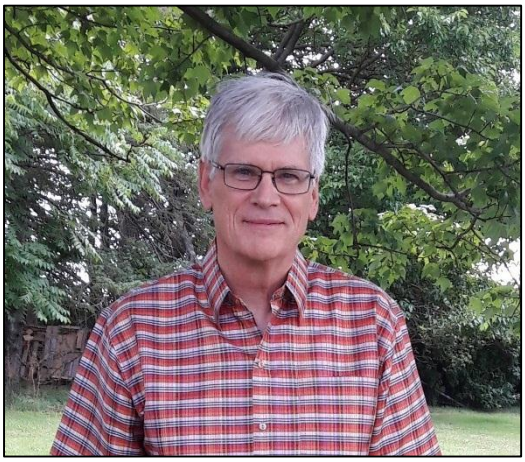
Finally, I'm happy to report that the Website Committee, Karen Rose Cercone (Chairperson), Peter Hutchinson, and Wendell Barner, is in the home-stretch of the PGS web-revision project. They and the web designer are fine-tuning the new website to work better on mobile devices and also to make sure the posted information is up-to-date and useful for PGS members and the general public. As for the identity of the volunteer web designer….well….she so happens to be my daughter, Pamella Sammons. All it took was my mention about the website during a casual conversation. I didn't even have to ask.

This Thanksgiving will have special meaning for me. See you on the 16th.

Peter R. Michael

President

PGS MEMBER SPOTLIGHT: PETER R. MICHAEL PG



Company, title or role: Semi-retired. Currently working part-time with the U.S. Office of Surface Mining Reclamation. Worked full time for the agency as Geologist from 1982 to 2015 conducting geo-technical investigations and providing regulatory program support.

How long have you been a member or PGS? Have forgotten. Guessing it's been 20 to 25 years.

Have you held any officer positions? Not until the current position as president.

Education: BS in Geology at Rider University, Lawrenceville, NJ, 1975; MA in Geology at Binghamton University, Binghamton, NY, 1984.

What are some of your day to day responsibilities in your current role? As a part-timer, editing geotechnical and geo-environmental investigative reports.

What is the best and worst thing about your current job? The best is the technical/scientific work and interaction with co-workers. The worst is the repetitive administrative stuff.

What was your first geology job out of college or weirdest geology job and did you learn anything you would like to pass on? Served as a soils geomorphologist in the US Peace Corps compiling landform maps for the Royal Thai Dept. of Land Development, Thailand, 1977-1981. This started after I completed my course work at graduate school. I gained a better appreciation of what is expected of a professional geologist at school but it was in the Peace Corps that I gained the confidence that I could perform up to those standards. I'd say the PC is a good option for any young person who is unsure what he/she wants to do in life.

What is your dream geology job? Pure field work in hilly or mountainous countryside in northern US or Canada while living in a comfortable cabin home. Hot chocolate on most evenings, Irish coffee on Saturday.

What is one thing you wish someone would have told you when you were starting out in the geology profession? Take advantage of opportunities that cross your path—be adaptable. Don't confine yourself to pre-conceived notions of what you are or what you think you should be doing.

What is one class you wish you would have taken in college? Philosophy of Science

What is the most exciting place you have been geologically?Northern Highlands and Northeastern Plateau in Thailand where I had my landform mapping projects when a Peace Corps volunteer. Also in the PA/NJ/NY tristate area where I did undergraduate field work.

What is your favorite or least favorite "Bad" geology movie and why? I don't like geology movies. Movies hyping disasters like earthquakes or huge meteors headed for Earth do not interest me. I say if you like geology, stick to the real thing, the science.

What's your favorite rock, mineral, or fossil? Garnet. It's both pretty and very inexpensive. I spent many happy boyhood summers in the Adirondacks and that's where I became acquainted with the mineral.

What is one of your favorite quotes? Something about each generation avoiding the mistakes of their parents by making the same mistakes of their grandparents. I don't know who said or wrote it and don't remember when I heard or read it.

If you could choose anyone, who would you pick as your mentor? The advisors I had at undergraduate and graduate school were fine. Wouldn't mind meeting them again.

If you could meet any geologist, living or dead, who would you meet? Dr. Donald Coates, glacial geomorphologist and professor at Binghamton U. He was my graduate school advisor from 1975 until 1977.

Anything else you would like to share about yourself? Just that I'm very grateful for having had an interesting career and even more interesting life.

GEOLOGICAL EVENTS

GEOPHYSICAL SOCIETY OF PITTSBURGH

November 1, 2016
Haihong (Iris) Wang, CGG – "Maximizing Recoverable Reserves in Tight Reservoirs Using Geostatistical Inversion from 3D Seismic: A Case Study from The Powder River Basin, USA" Cefalo's Event Center, Carnegie PA.

HARRISBURG GEOLOGICAL SOCIETY

November 10, 2016
Dr. Dorothy Merritts, F&M College – "Pennsylvania's Freeze-dried Landscapes & How They Matter to Dam Removal, Stream Restoration, and the Chesapeake Bay" Fiesta Mexico Restaurant, Harrisburg PA

PENNSYLVANIA COUNCIL OF PROFESSIONAL GEOLOGISTS

December 13, 2016
Vapor Intrusion Technical Guidance Seminar, Regional Learning Alliance, 850 Cranberry Woods Drive, Cranberry PA

29TH ANNUAL CENTRAL PENNSYLVANIA GEOTECHNICAL CONFERENCE

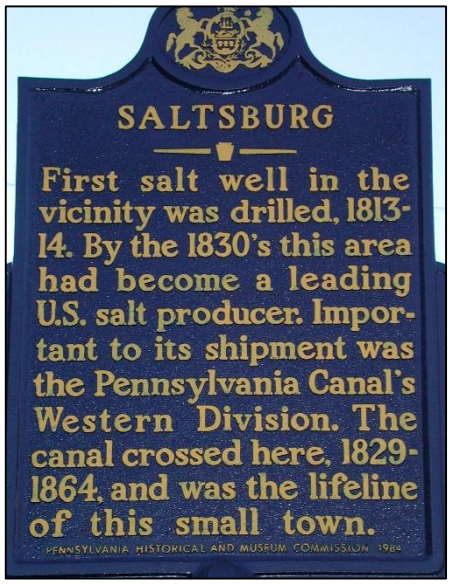
January 25-27, 2017
Speakers Include: Johanna Simon – "A Hybrid Retaining Wall to Conquer a Massive Slope" ; Steve Wendland – "Impacts of Superfast Construction on Slope Stability"; John Wolosick – "Revisiting Normandy Beach - Bluff Stabilization"; David Elton – "A Brief History of Geotechnical Mistakes" and many others. 10 PDH credits available to attendees. Hershey Lodge and Convention Center, Hershey PA

The Pittsburgh Geological Society welcomes the following new student members to the society:

From California University of PA

Jacob M. Podrasky
Tyler R. Rowe
Amy K. Burnett

UPCOMING EVENTS OF INTEREST TO PGS MEMBERS



SAVE THE DATE - 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. Stay tuned for more information and registration deadlines in upcoming newsletters!

2017 GSA Joint Section Meeting

NORTHEASTERN (52ND) AND NORTH-CENTRAL (51ST)

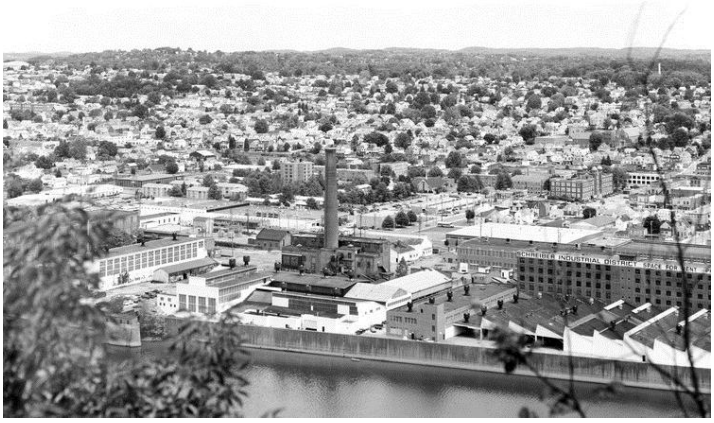
Shale Gas Production:

Views from the Energy Roller Coaster

19–21 March 2017 • Pittsburgh, Pennsylvania, USA

THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES

New Kensington, a small city in northwestern Westmoreland County, originally was just farmland in Burrell Township. It was founded, in 1891 when a group of real estate speculators, who thought the level stretch of land above the Allegheny River would be ideal for development, formed the Burrell Improvement Company and purchased the farmland. It was then surveyed and laid out in numbered streets. A public sale was held in 1891 in which the company gave out free rides on the railroad, causing thousands of people to flock to the area to see if they could buy some land. This attracted investors who brought industry to the area, including the Pittsburgh Reduction Company, the original name of Alcoa. Alcoa's facility on the Allegheny River remained operational until the 1960s. Other companies followed and New Kensington grew. Originally named Kensington, the city was renamed because there already was a Kensington Post Office in eastern Pennsylvania (now considered to be a neighborhood of Philadelphia). New Kensington was incorporated as a borough in November, 1892. Some of New Kensington's more notable former residents include nationally known poet Ray DiPalma, composer and jazz pianist William Thomas McKinley, and Willie Thrower of the Chicago Bears (1953-54), the first African-American quarterback to play in the NFL since shunning of black players in 1928



Former Alcoa plant in New Kensington

DID YOU KNOW . . . ?

A Namibian farmer plowing his field in 1920 ran into a large metallic object. When it was uncovered, word got out and it was identified as a meteorite. Such finds are not uncommon. What is uncommon about this find was the the size of the meteorite. The farmer had discovered a 66-ton iron meteorite. Called the Hoba Meteorite, it is the largest meteorite ever found as well as the largest piece of iron ever found near Earth's surface. It is about nine feet long, nine feet wide and about three feet thick. Hoba, which is composed of about 84% iron, 16% nickel, and trace amounts of cobalt and other metals, is thought to have fallen to Earth about 80 ka. The abundance of iron oxides in the soil around the meteorite suggests that it was originally a lot bigger than 66 tons and has since suffered significant losses from oxidation. One of the surprising things about Hoba is that it did not form an obvious crater, something definitely expected from an meteorite of this size. The lack of a crater suggests that it fell to Earth at a lower rate of speed than would have been expected. Some scientists think that a possible low velocity at impact would have been the result of its the flat shape. Although it has been excavated, the meteorite has not been moved from where it was discovered because of its enormous weight, but small pieces have been removed for scientific study and through vandalism. The Namibian government has declared the meteorite and the site where it rests as a national monument. The site now has a small tourist center and is visited by thousands of people each year.

Hoba Meteorite, the largest meteorite known on Earth

Australia is on the move. Since the last adjustment to its location was made in 1994, it has moved 4.9 feet because the plate it sits on has been moving at about 2.7 inches a year northward and with a slight clockwise rotation. In contrast,

Australia is on the move

the North American plate has been moving roughly 1 inch a year and the Pacific plate moves 3 to 4 inches a year. Thus, when there is a significant shift in land masses over time continental locations need to be revised. Shifting is becoming more focused as GPS systems get more accurate. Although most cellphone GPS's don't have such a significant level of accuracy, the most advanced technologies can pinpoint a location to a matter of inches. Such precise GPS technology is being used in other ways, too, such as in self-driving cars. Meanwhile, Australia, which tends to move especially fast due to its unique geology, has required corrections to its latitude and longitude four times over the past 50 years. When the previous adjustment was made in 1994, it was about 656 feet.

Expansive soils typically contain water- absorptive clay minerals such as smectite that, when they absorb water, increase in volume. The more water they absorb the more their volume increases such that expansions of 10% or more are not uncommon. A change of that sort is capable of exerting enough force on a structure to cause significant damage such as cracked foundations, floors, and basement walls. If motion in the structure is significant, it can cause damage to upper floors as well. To add insult to injury, when such expansive soils dry out, they can also shrink, removing support from structures that result in subsidence damage, as well as cracks in the soil that facilitate the deep penetration of water when precipitation or runoff occurs. This produces a cycle of shrinkage and swelling that places repetitive stress on structures. The American Society of Civil Engineers (ASCE) estimates that 25% of all homes in the US have some damage caused by expansive soils. In a typical year expansive soils cause more financial loss of property than earthquakes, floods, hurricanes, and tornadoes combined. Despite this, most people are completely unaware of expansive soils and the destruction they cause, mostly because damage is slow and cumulative and typically can't be attributed to a specific event. The end result is that the damage is blamed on poor construction practices, and many people end up with the misconception that all buildings experience this type of damage as they age.

Damage to basement wall caused by expansive soils

The highest known tsunami occurred in Lituya Bay in the Alaska Panhandle on the night of July 9, 1958. Lituya Bay is a fjord-like tidal inlet on the northeast shore of the Gulf of Alaska measuring seven miles long and up to two miles wide, with a maximum depth of about 720 feet. A fault zone called the Fairweather Fault trends across the northeast end of the bay, causing the bay to have a T-shape. An earthquake along the fault on that night loosened about 40 million cubic yards of rock on the steep cliffs above the northeastern shore of the bay (marked in red on the map above) that fell about 3,000 feet into the water. This generated a local tsunami that smashed against the opposite shoreline with such power that it swept completely over the spur of land

Lituya Bay, Alaska, is the site of the highest known tsunami, the result of an earthquake along the fault that gives the bay its T-shape

separating it from the main body of the bay. The wave continued down the entire length of the bay, over a spit of land at the mouth of the bay, and into the Gulf of Alaska, mowing down millions of trees and removing vegetation from elevations as high as 1,720 feet above sea level. One eye witness described the tsunami as a straight wall of water about 100 feet high that extended from shore to shore in the bay. Another, who was on his boat at the time, rode the tsunami down the bay to the Gulf, looking down on the trees growing on the spit more than 80 feet above their tops. The wave crest broke just outside the spit.

The Patagonian region of Argentina has proven to be rich in Late Cretaceous fossils that show how the dinosaurs living there behaved. A new Late Cretaceous dinosaur skeleton from northern Patagonia is interesting because, like *Tyrannosaurus rex*, it had tiny arms, indicating that such unusual forelimbs must have evolved several times. The dinosaur, which named *Gualicho shinyae*, is a new theropod species that probably forms a sister taxon to the African dinosaur *Deltadromeus*. Although the *Gualicho* skeleton is incomplete, the paleontologists who discovered it estimate that it was probably a medium-sized slender predator weighing around a half ton, about the same size as a polar bear. The skeleton shares many anatomical similarities with its African cousin, but, despite its size, the forelimbs are comparable in size to that of a human child's, and the claws had just two digits. These arms are far more similar to those of the distantly-related T. rex than to more closely-related species and may indicate that the forelimbs evolved independently on two branches of the evolutionary tree, rather than arising from a common short-armed ancestor. *Gualicho* is kind of a mosaic dinosaur, having features you would normally see in different kinds of theropods, making it different from other carnivorous dinosaurs found in the same rock formation. The paleontologists find that it doesn't fit neatly into any category. It is not known why these dinosaurs had disproportionately small forearms.

Two *Gualicho shinyea* about to have lunch

A new study on the Greenland Ice Sheet provides insight on climate change by using a different research method to establish estimates of ice loss in both modern and ancient times. The study improves estimates of past and present-day ice loss by exploring the Earth's activity beneath the ice sheet. Such research opens up new opportunities for better understanding how the ice sheet is changing and interacting with the rocky layers below it. When the ice sheet loses ice, the crust underneath rises, a phenomenon called postglacial rebound. Because of rebound, scientists can't measure how much an ice sheet is shrinking simply by tracking changes in its surface elevation. Instead, they also have to determine how much of any surface elevation change is caused by the rising bedrock. This new study used data from GPS stations fixed on bedrock, rather than ice, to capture the uplift process in unprecedented detail, showing that earlier studies may have underestimated past and present-day mass loss. The research also suggests that the mantle beneath Greenland is not uniform. To the southeast, the island has experienced unexpectedly rapid uplift rates of about 12 millimeters per year. This suggests that the mantle may be hotter and less viscous here, making it “springier”.

Because there is an acute scarcity of the most ancient rocks, the composition of Earth's early crust, during the Hadean Eon about 4,000 ma, is unknown, affecting research to understand how the earliest continents evolved. Was the Hadean Earth dominated by mafic crust like that beneath today's oceans, or did it include significant amounts of continental crust? The answer could have major implications for the earliest atmosphere, the origin of life, and the geochemical evolution of the crust–mantle system.

Tonalitic gneiss from the Acasta Gneiss Complex in northwestern Canada

Now, in a new study, researchers used U–Pb and Hf isotope data on zircons from a tonalitic gneiss in the Acasta Gneiss Complex of Canada, at 4,019.6 ± 1.8 ma, the only precisely-dated Hadean rocks on Earth. Geochemical data from this unit indicate that there's been no derivation from, or interaction with, older Hadean continental crust. The researchers believe their data provide the first direct evidence that the oldest known evolved crust on Earth was generated from an older ultramafic or mafic reservoir that probably formed the surface of the early Earth.

Scientists have been wondering why, after 3 billion years of life on Earth with nothing more complex than algae, all of a sudden complex animals suddenly started appearing. A team of researchers has finally come up with some strong evidence to support the hypothesis that high levels of oxygen in the oceans were crucial for the emergence of skeletal animals just before the beginning of the Cambrian Period. The new study, which distinguishes between waters with low and high levels of oxygen, shows that poorly oxygenated waters would not support complex life that evolved just prior to the Cambrian, suggesting that oxygen was a key factor in the emergence of complex life.

Although geochemical evidence has existed for years linking a rise in oceanic oxygen levels with the timing of the appearance of more complex animals, it has been really difficult to prove a causal link. The new study demonstrated that early skeletal animals were restricted to well-oxygenated waters. But such well-oxygenated environments may have been relatively rare, thus limiting the amount of habitable space in the ocean for the earliest animals.

The research team analyzed the chemical elemental composition of rock samples from the ancient seafloor in the Nama Group of Namibia that contain abundant fossils of early animal forms such as *Cloudina*, *Namacalathus*, and *Namapoikia*. They found that the levels of cerium and iron found in the rocks indicated that low-oxygen conditions occurred between well-oxygenated surface waters and fully anoxic deep waters. Although they seemed to be abundant in the well-oxygenated environments, the early skeletal animals did not occupy oxygen-poor regions of the shelf. This demonstrated that oxygen availability was a key requirement for the development of early animal-based ecosystems.

Some early complex animals that evolved just before the Cambrian

The research team honed in on the last 10 ma of the Proterozoic as the time in Earth's history when the major animal groups first grew shells and began bioturbating bottom sediment. They found that oxygen levels were important to the relationship between environmental conditions and the early development of animals.

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PGS Website of the Month

http://www.sandatlas.org/composition-of-the-earths-crust/

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		Continuing Ed:	Frank Benacquista	**AAPG Delegate:**	Dan Billman

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Officer Contacts: If you wish to contact a current PGS Officer, you can email Peter Michael, President, at shabell9@comcast.net; Tamra Schiappa, Vice President and Speaker Coordinator, at tamra.schiappa@sru.edu; Kyle Fredrick, Treasurer, at fredrick@calu.edu; and Karen Rose Cercone, Secretary and Newsletter Editor, at kcercone@iup.edu.

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** on your mobile Twitter app.

Fun Fact Having Nothing to Do with Geology

The first self-service grocery store was Piggly Wiggly, which opened its doors on Jefferson Street in Memphis, Tennessee, 100 years ago (1916).