PITTSBURGH GEOLOGICAL SOCIETY

Upper Paleolithic Cave Art of Northern Spain

Richard Smosna & Kathy Bruner

Professors of Geology
West Virginia University

November 16, 2022

MEETING TIMES

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

DINNER COSTS

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

RESERVATIONS

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

Or reserve and use PayPal: https://www.pittsburghgeologicalsociety.org/

MEETING LOCATION

Cefalo's Banquet & Event Center, Carnegie PA

COVID19 POLICY

See page 3 for current guidance.

Please RSVP by Wednesday, November 9

Speaker Abstract

Early Modern Humans of Western Europe, living from 35000 to 10000 BP, were prolific artists, depicting as many as 30 different species of animals on cave walls. The artists worked in a number of media, including engravings with chert point, mineral paints (black, red-ochre, and white), and air brushing. They illuminated the interior cave rooms with torches and stone lamps, and constructed scaffolding to reach high ceilings. Earliest artwork consisted of abstract geometric designs (lines, 2-d shapes, dots, dashes) and simple line engravings of animals. These animals lacked perspective and depth, but later paintings made use of different colors, shading, internal lines, and wall contour, giving a three-dimensional realism with volume and relief. And with various artistic techniques, animals could be shown turning, running, or jumping. Generally, though, there is no alignment of the many animal forms on a single wall, no proportionality in size, and considerable overlap of figures, all of which appear confusing to our eyes but were intentional by the artists. The depiction of human forms was rare: female profile, pubic triangle, and vulva, bird-man with human penis, human face mask. The Big Question, of course, is Why? Artistic expression? Lucky walls for the next hunt? Current Events? Religious rites? The most commonly accepted hypothesis today is that these drawings were symbols of something abstract, outward expressions of inner thoughts. They stood for happenings in the natural environment, they played a role in stories, the pictures were used in ceremonies, and they translated rituals into images.

Speaker Biography

Richard Smosna and Kathy Bruner are retired faculty members at WVU who have taught geology since the Jurassic Period, presenting courses in sedimentology and stratigraphy, Earth history, dinosaurs, human evolution, oceanography, and petroleum.

Please note that PGS is monitoring the COVID-19 situation closely and will continue to modify policy based on the recommendation of national and local experts. We ask that our members please consult and follow the US Centers for Disease Control and Prevention (CDC) recommendations for Allegheny County as shown here: https://www.cdc.gov/coronavirus/2019-ncov/your-health/covid-by-county.html

UPCOMING PGS MONTHLY MEETINGS

Meeting Date	Scheduled Speaker	Presentation Topic
December 14, 2022*	Craig Eckert	"Rocks, Roots and Rattlesnakes: Walking the Appalachian Trail"
January 19, 2023	Joint PGS – AEG – ASCE Meeting	
February 15, 2023	Darcy Lecture: Dr A. Wilson	"Subseafloor Hydrogeology: Moving beyond Watersheds"
March 15, 2023	Dr. Peter Dodson University of Pennsylvania	"Collecting Dinosaurs on Four Continents"
April 19, 2023	Student Night	
May 10, 2023	2021 ES AAPG Winner of PGS Best Presentation on Appalachian Geology: James McDonald	"History of Structure Contour Mapping in the Appalachian Basin: 1870-1917"

* *December meeting held at LeMont Restaurant on Mt. Washington*

The Pittsburgh Geological Society welcomes our new member:

New Regular Member:

Doug G. Patchen, Program Manager, WV Energy Institute

Doug has a PhD in Geology from Syracuse University. He was a long-time member of the West Virginia Geologic and Economic Survey before working at WVU's NRCCE, now the Energy Institute. I have known Doug for close to 40 years. He was the organizer of the Appalachian Oil and Natural Gas Research Consortium (AONGRC), of which the PA Survey was a partner on many projects, including a study of the Cambrian Gatesburg Formation, the Gas Atlas, and the Trenton-Black River Project. Doug had been a long-time member of other regional and national societies but never thought to join PGS until now. Welcome aboard, Doug!

John Harper

PRESIDENT'S STATEMENT

Hello again PGS members! I'm looking forward to seeing you all again at our November meeting, it sounds like a phenomenal talk and I'm excited to see Dick and Kathy. I would also like to offer a special thank you to Pete Hutchinson and THG Geophysics for the generous donation of wine service for our October meeting and to Dr. Scott Burns for not only making the travel all the way to Pittsburgh from Portland, Oregon, but also for bringing some wines to sample. The talk was fantastic and it was also fun to meet in a different and unique venue. Thanks to all of those involved in making it happen and I'm looking forward to more exciting events, including the release of the Mindful Brewing collaborative brew on November 9th and the special partner's night December meeting at Le Mont. This is shaping up to be an exciting year!

There weren't a lot of announcements at the October meeting, so I'll take an opportunity here to advertise some of our committees with a call to the membership to get involved. Several of the PGS Board members also serve on committees that may be found on the PGS website: https://pittsburghgeologicalsociety.org/board-of-directors.html

All of our committees could use help. Being active in a committee is also a great way to learn more about PGS business and to voice your opinion about PGS activity. If you've ever had some ideas or suggestions for the board, participation in a committee is a good way to get your ideas out there. Do you have suggestions or thoughts about new or unique awards for recognition of local service? Consider the Awards Committee! Interested in community service or public communication of geologic issues? Consider the Education Outreach Committee! With over 15 committees and Ad Hoc committees to choose from, there are many ways to get involved and the board would welcome all help and innovative ideas.

I hope the weather cooperates with our upcoming winter meetings and I hope to see you all soon! Drive safe!

Dan

LOCAL GEOLOGICAL EVENTS

PENNSYLVANIA COUNCIL OF PROFESSIONAL GEOLOGISTS (PCPG)

October 31, 2022 **1:00 PM - 2:00 PM**

Webinar: "Forensic Geophysical Methods Used to Assist Law Enforcement Agencies with Locating Clandestine Graves (60 mins.)" by Tom Jordan, Ph.D., P.G., Supervising Geologist, KEY Environmental.

Details and registration: https://pcpg.org/event-4968637

PGH PETROLEUM GEOLOGISTS / GEOPHYSICAL SOCIETY PGH (PAPG & GSP)

November 1, 2022 **11:30 AM - 1:00 PM**

"Unsupervised Classification Techniques to Update Type Curves in the Marcellus Shale" by Amanda Trumbo, Sr. Staff Geophysicist, Chesapeake Energy Corporation

Details and registration: https://www.thegsp.org/event-5001818 or https://www.papgrocks.org/login

virtual or in-person at **Cefalo's Banquet and Event Center, Carnegie, PA**

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS (AAPG)

November 2, 2022 **11:00AM**

"AAPG Academy: Orphan Wells, Part 2: How to Properly P&A an Orphan Well, plus Govt Research and Programs" Dan Arthur, ALL Consultants, Nick Gianoutsos, USGS, Mileva Radonjic, Oklahoma State U.

Series supported by AAPG's Division of Professional Affairs and the Division of Environmental Geoscience registration: https://aapg.zoom.us/meeting/register/tZUsfuGupzMvHdIxbPFP7v1iFFWWjE3i_ypQ

For 1.5 Professional Development Hours, please register here: https://www.eventbrite.com/e/orphan-wells-part-2-professional-development-hours-tickets-449555000107

HARRISBURG AREA GEOLOGICAL SOCIETY (HAGS)

November 10, 2022 **6:30 PM – 7:30 PM**

"Benefits of a Budget-Conscious Drone Program" by Craig Ebersole, Pennsylvania Geological Survey

In-person or Virtual – Details and registration: https://bit.ly/3TnHbq6

ANNOUNCING PITTSBURGH RED BED AMBER LAGER

A collaborative beer between Mindful Brewing & PGS

November 9, 2022 **Release Party starting at 4:00 PM**

Castle Shannon location of Mindful Brewing, 3759 Library Rd, Pittsburgh, PA 15234

Mindful Brewing's original location where the beer is actually brewed. Meet and talk to the brewmaster, creator of the beer, Adam. The canning will be completed on 11/8 and the beer will become available on Wednesday, the 9th. For the release party, they'll have it on draft and available in cans to purchase for ON and OFF sale. Pour it in 16 oz commemorative glasses! Live music! We will have a special set-up on the second floor and the full menu will be available if you'd like to buy food. That night, Mindful will be hosting their entire facility's dinner service as a dine-in fundraiser, so a portion of the ENTIRE RESTAURANT'S PROCEEDS will come to PGS for the Galey Fund!!! As this launches, tell your friends, colleagues, neighbors, enemies, EVERYBODY, to come try out the PGS/Mindful beer. There are two additional locations of Mindful, too, so the beer will be available at all three, including the Carnegie one (only 0.6 miles from Cefalo's) and the newest location in Bloomfield on Liberty Avenue!

YOU CAN STILL ORDER YOUR OWN PGS SWAG!

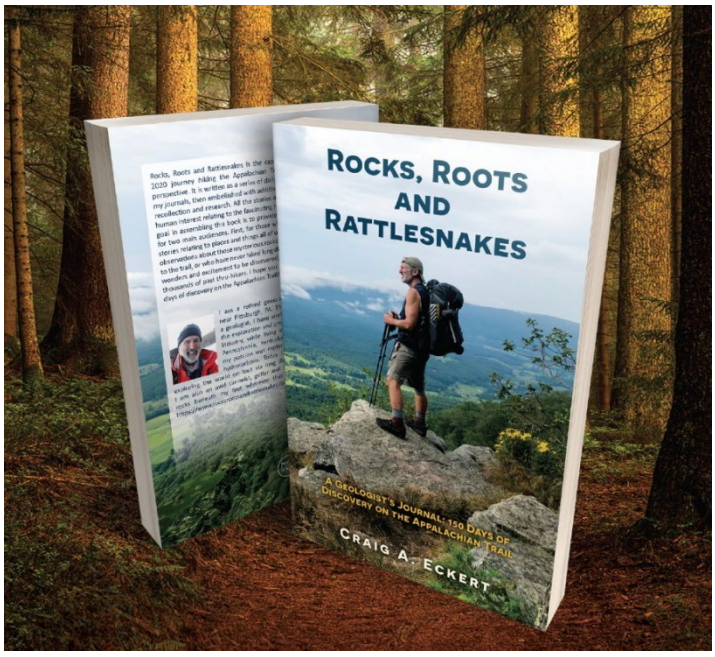
Show off your PGS Membership by purchasing a hoodie, t-shirt, or bumper sticker at the new PGS merchandise store. All proceeds support geology student participation in PGS society meetings!

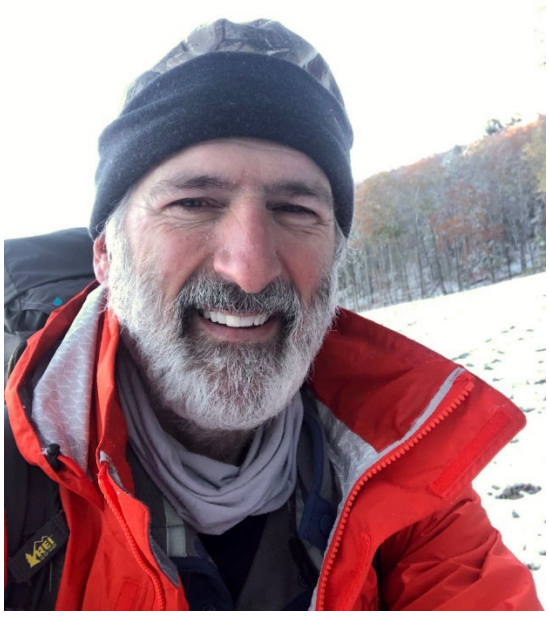
https://apparelnow.com/pittsburgh-geological-society-apparel

LISTEN TO CRAIG'S ADVENTURES AT DECEMBER'S PGS MEETING AT MT. WASHINGTON'S LE MONT RESTAURANT!

READ A BOOK WITH A LOCAL GEOLOGY CONNECTION!

In June of 2020, Pittsburgh-based geologist and former PGS President Craig Eckert set off on a thru-hike of the Appalachian Trail, a journey that took him past numerous rocks and scenic landscapes. He decided to keep a daily log about the geologic observations he made along the way. In *Rocks, Roots, and Rattlesnakes*, Craig reflects on the sedimentary, igneous, metamorphic and tectonic history of our favorite local mountain chain, weaving an assortment of published data with his own geologic observations. His book makes a great gift for a geologist or a future trail hiker. You can purchase it now at Craig's website: https://www.rocksrootsandrattlesnakes.com/.



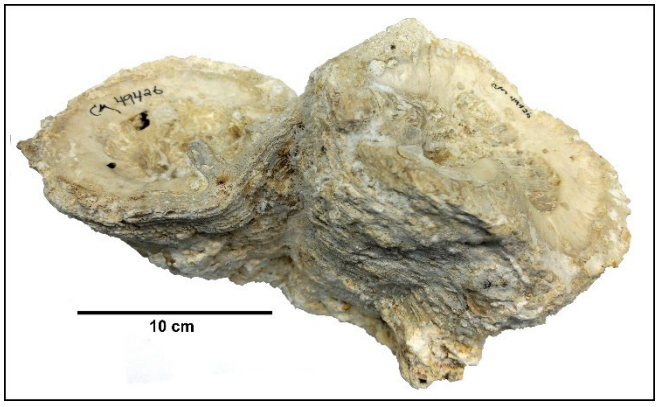


THE ORIGIN OF WESTERN PENNSYLVANIA PLACE NAMES

Kennywood Park in West Mifflin is an iconic amusement park that was recently named one of the best amusement parks (with the best coasters) in the country in national survey.

The Borough of West Mifflin, in Allegheny County, had a long and complicated history. Originally called Mifflin Township and named in honor of the first Elected Governor of Pennsylvania, Thomas Mifflin (1744-1800), it had been part of Yohogania County, Virginia until 1784 when land was purchased to form Washington and Westmoreland counties. Then in 1788, Allegheny County was formed from parts of those counties, and Mifflin Township was one of Allegheny's seven original townships. The township boundaries began at the mouth of Streets Run in what is now Hays (part of Pittsburgh's 31st Ward), up the Monongahela River to Washington County and then south from there to Saint Clair Township (now Upper St. Clair). The township covered more than 12 miles along the river and included Hays, West Homestead, Munhall, Whitaker, Duquesne, Dravosburg, Lincoln Place, Jefferson Hills, Pleasant Hills. and part of Baldwin. Over the years, a series of annexations and secessions reduced it to 14.35 mi^2. In 1941, the township was incorporated as a borough, the first time an entire township became a borough. In January 1944, the name was changed to West Mifflin, 156 years after being carved out of Washington and Westmoreland counties. The word "West" was added because there was already a Mifflin County and a town of Mifflin in Juniata County, both in central Pennsylvania. West Mifflin is home to Pittsburgh's premiere theme park, Kennywood Park, which has been celebrating its 125th anniversary this year.

DID YOU KNOW . . . ?



***Hippurites*, a genus of rudist bivalves that formed reefs during the Cretaceous. This specimen, CM 49426 from France, is in the collections of the Carnegie Museum of Natural History.**

According to a new study of fossil molluscs by a team of researchers from Belgium, Earth was rotating on its axis faster at the end of the Cretaceous than it is today, with a year of 372 days instead of the current 365 days. At that rate, a day lasted only 23½ hours. The molluscs studied were rudists, a group of bizarre reef-building bivalves that existed only in the Cretaceous and went extinct with the non-avian dinosaurs. They built vast reefs, taking on the role of ecosystem constructors that reef corals have today. They also grew rapidly and deposited shell material daily as growth rings, similar to those of trees. The researchers used lasers to sample minute fragments of shell material and to count the growth rings more accurately than could be done using microscopes. The growth rings not only allowed the researchers to establish the number of days in a year and more precisely determine the length of a day 70 ma ago; in addition, they also revealed extraordinary details about rudist biology and paleoenvironment, based on four or five data points per day. Although

typical paleoclimate reconstructions normally explain long-term changes on a scale of tens of thousands of years or more, this study took a look at climate change within the time scale of the rudists, providing the potential to connect the disparity between climate and weather models. Chemical analysis of the shells indicated that Late Cretaceous ocean temperatures were warmer than previously thought, reaching 104°F in the summer and more than 86°F in winter. The researchers examined one shell collected in the mountains of Oman that had lived more than nine years in shallow tropical water. They found the composition of the shell material changed more during the course of a day than over the seasons, or even with tidal cycles. Fine-scale resolution of the daily layers showed that the shell grew much faster during the day than at night. Assuming rudists fed mainly by filtering food from the water, like today's clams and oysters, this suggested that daylight was more important than expected and provided evidence verifying that rudists sheltered symbiotic photosynthetic algae that fed on sunlight and assisted with reef building, similar to the symbiotic algae modern corals incorporate into their shells to build reefs. The study also updated models of the formation of the Moon and how close it has been to Earth over the past 4.5 ga. Although length of a year has been constant throughout Earth's history, the number of days within a year has been getting shorter over time because the days have been getting longer as ocean tidal friction, caused by the Moon's gravity, slows Earth's rotation. At the same time, tidal pull accelerates the Moon slightly in its orbit. As Earth's rotation slows, the Moon moves farther away, calculated at 1.5 inches per year. Careful measurement of the Moon's distance from Earth using lasers has been demonstrating this ever since the Apollo program left reflectors on the Moon's surface. Still, scientists suggest that the Moon could not have been receding at this rate throughout its history. By projecting the satellite's progress back in time, it has been concluded that the Moon would have been within Earth's orbit only 1.4 ga ago, yet we know from other evidence that it has been orbiting Earth much longer, probably since forming more than 4.5 ga ago. Therefore, the rate of the Moon's retreat must have changed over time. This makes the information from rudists very valuable in helping researchers piece together that history and the model of the Moon's formation.

https://mjaac.com/mollusk-fossils-show-days-were-half-an-hour-shorter-70-million-years-ago.html

Park rangers were becoming alarmed at some odd white structures that have been appearing at the Great Salt Lake in Utah over the past few winters, so they contacted the Utah Geological Survey (UGS) looking for answers to what was happening. The geologists looked at photos and took samples. Their analysis was that the chalky white heaps were mounds of mirabilite, also known as Glauber's salt, a hydrous sodium sulfate mineral with the chemical formula of $Na_2SO_4 \cdot 10H_20$.

Two mirabilite mounds along the Great Salt Lake shoreline.

Much of the salt and minerals found in the lake are remnants from its previous iteration as Pleistocene Lake Bonneville. These are rare geological formations that occur when groundwater reacts with minerals and comes to the surface, where it intermingles with cold winter air to form white crystals. This portion of the Great Salt Lake normally would be covered in water during the winter and, therefore, wouldn't be susceptible to the phenomenon. Since the winter of 2019, however, the fragile mounds have become a common occurrence on the sandy lakeshore. Initially, the rangers noticed only four mounds, but by 2022 they had documented 15. The mounds have also gotten larger. One measured 3 feet high, and in 2021 there was a mirabilite mound that was 35 feet long. The UGS speculated that more mounds were forming each year because, as the mounds grow, they ultimately close off the source of groundwater

coming to the surface, causing it to find new pathways and producing new growths. Also, since 2019, lake levels have dropped significantly, contributing the perfect conditions for the mounds to form. According to the USGS, average daily water levels in July 2021 dropped an inch, the largest decrease known since 1963 and the largest change since it began recording lake levels in 1847. On July 3rd of this year, the lake hit its lowest record level ever. Research shows the mounds begin to form when the water's elevation falls below 4,194 feet above mean sea level. When the lake levels are higher, the groundwater springs typically are covered by salt water, so they aren't visible. In order for the mirabilites to form, the local conditions need to be a perfect mix of sub-freezing temperatures and dry, which is why they are only seen in the winter. Similar formations have been seen in polar regions such as Antarctica. As a result of reports on the mounds by local new media, Great Salt Lake State Park has begun offering tours to the public, and slots have been filling up quickly. One local university has been collecting samples to study the biological character of the mounds. A blog post by Utah State Parks even suggested there might be a possible Mars connection: the lake mounds potentially could serve as an analog for researchers to consider because Mars shares similar characteristics to the Great Salt Lake's shore, including an arid environment. This possible connection is more hypothetical, of course, based entirely on satellite imagery of the Red Planet. Some images show topographic mounds that some researchers think could be similar in composition. The mounds disappear when summer comes around, resulting in little more than a thin layer of white powder called thenardite (Na_2SO_4).

https://gizmodo.com/great-salt-lake-mirabilite-mounds-1849492129

One of the basic features of Earth's tectonic evolution involves the cycle of supercontinent assembly and the subsequent dispersal of major continents that occurs with a periodicity of about 600 ma. This cycle has been going on since at least two ga ago and includes Nuna/Columbia (1.6-1.3 ga ago), Rodinia (900-700 ma ago), and Pangea (320-170 ma ago). Researchers who

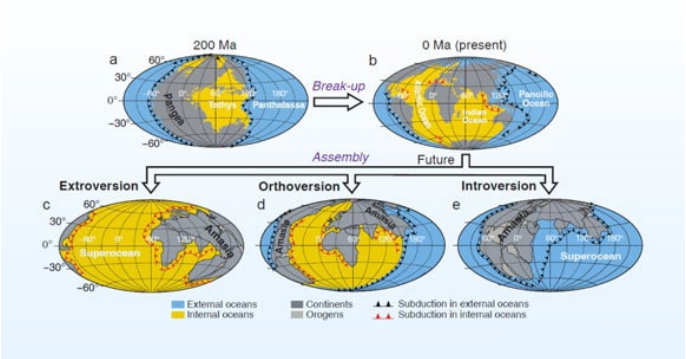
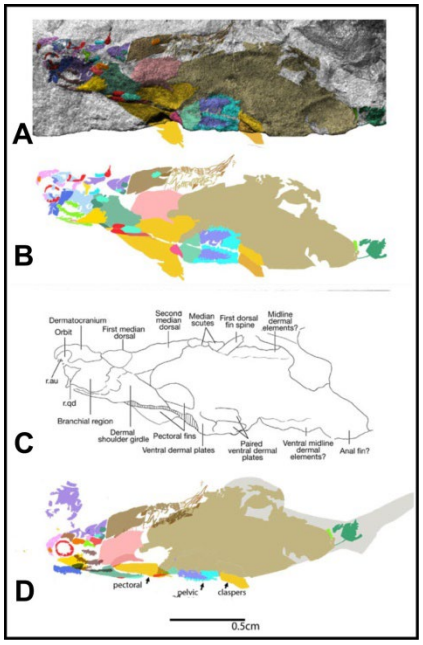


Illustration of three potential ways of assembling a future supercontinent since the break-up of Pangaea (a and b); c = extroversion, d=orthoversion, and e=introversion.

study this cycle have proposed two endmembers called introversion and extroversion assembly. Introversion assembly comprises closure of internal oceans created during the break-up of the previous supercontinent. Extroversion assembly involves closure of the external super-ocean that surrounded the previous supercontinent. Nuna/Columbia possibly was the first, so its assembly does not involve the introversion/extroversion processes as far as we know. How Rodinia and Pangea formed remains controversial. Recently, a team of researchers from Australia and China used a supercomputer to simulate how a supercontinent forms. They found that because the Earth has been cooling for billions of years, the thickness and strength of the plates under the oceans reduce with time. This makes it difficult for the next supercontinent to assemble by closing the young oceans, such as the Atlantic or Indian oceans. Their findings provide insights into what would happen over the next 200 ma. Because of the known supercontinent cycle, the current continents are due to assemble into a supercontinent sometime in a few hundred million years. The new supercontinent has already been named Amasia because there is some belief that the assembly will involve closure of the Pacific Ocean rather than the Atlantic and Indian oceans when America collides with Asia. Australia is expected to collide first with Asia and eventually connect America and Asia once the Pacific has closed. The computer simulations showed how Earth's tectonic plates are expected to change so that, in less than 300 ma, the Pacific Ocean likely will close, permitting the formation of Amasia. The Pacific is the remnant of the Panthalassa super-ocean that

began forming 700 ma ago when Rodinia began to break up. As such, it is the planet's oldest ocean. It started shrinking from its maximum size during the Mesozoic and is currently shrinking by a few centimeters per year. At present, it has an area of about 57,000,000 mi^2, and is about 15,500 miles wide between North America and Asia. Having the Earth dominated by a single continental mass would dramatically alter the planet's ecosystem and environment, making it a drastically different planet when Amasia has assembled. For example, sea level is expected to be lower, and the interior of the supercontinent will likely be arid with high diurnal temperatures. Compare that with the current make-up of seven continents with widely different ecosystems and human cultures. It would be fascinating to see what the world might look like in another 200 to 300 ma.
https://www.sci.news/othersciences/geophysics/supercontinent-amasia-11247.html

New molecular studies suggest that the jawed vertebrates originated no later than the Late



***Shenacanthus vermiformis*, an early Silurian cartilaginous fish that developed armor plating similar to that found in placoderms.**

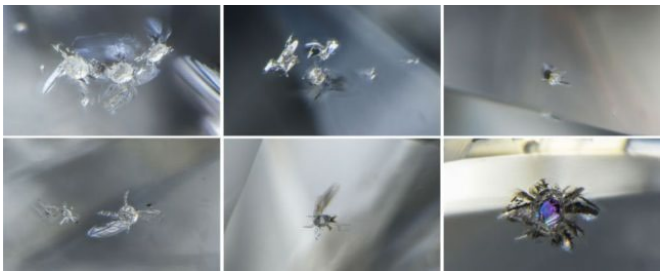
A – fossil with a colorized overlay shown in B;

C – line drawing of the colored sections with parts identified;

D – reconstruction of the fish with the colors.

Ordovician period (~450 ma ago). Analyses, combined with disarticulated microfossils of supposed chondrichthyans (cartilaginous fish like sharks and rays) from the Ordovician and early Silurian, suggest the occurrence of an evolutionary explosion of jawed vertebrates before and immediately after the end-Ordovician mass extinction event. Until recently, the earliest complete fossils of fishes with jaws that permitted detailed reconstruction of their morphology came from late Silurian assemblages (~425 ma). The deficiency of complete, articulated body fossils from before the late Silurian has obscured the earliest history of jawed vertebrates. Recently, a team of researchers from China reported a newly discovered *Konservat-Lagerstätte* (a sedimentary deposit that exhibits extraordinary fossils with exceptional preservation) denoted by the existence of assorted, well-preserved jawed fishes, including complete bodies, from the early Silurian (~436 ma) of Chongqing, South China. The dominant species encountered was a placoderm (armored fish) named *Xiushanosteus mirabilis*. This fish exhibited characters combined from major placoderm subgroups and presaged the transformation of the skull's roof pattern from placoderms to osteichthyans (bony fish). In addition, the researchers encountered a chondrichthyan they named *Shenacanthus vermiformis* that displayed extensive armor plating of the upper and middle back, and a large median dorsal plate, similar to those found in placoderms but which previously had been unknown in conventional chondrichthyans. Both of these species revealed a previously unknown diversification of jawed vertebrates in the early Silurian, and provided detailed insights into the whole-body morphology of the jawed vertebrates of this period.
https://www.nature.com/articles/s41586-022-05136-8

A recently unearthed diamond from a mine in Botswana has provided a clue to an enigmatic process occurring in Earth's interior. The diamond isn't perfect, by any means; it is replete with flaws containing traces of ringwoodite (Mg_2SiO_4), ferropericlase ((Mg,Fe)O), enstatite ($MgSiO_3$), and other minerals suggesting it formed about 410 miles beneath the surface of the planet. They also suggest that the environment where they formed in the transition zone between the upper and lower mantle is rich in water. The occurrence of ringwoodite, including hydrous phases, suggests the environment at this boundary is wet. Now, a team of researchers propose there's enough water at that interface hundreds of miles deep to make the planet's ocean seem like a



Photos of some of the inclusions found in a diamond from a mine in Botswana. They include enstatite, ringwoodite, coesite, and possibly perovskite.

puddle by comparison. The many subduction zones on Earth's tectonically active crust allow water to seep from the ocean depths deep into the planet, reaching as far as the lower mantle. Over time that water returns to the surface through volcanic activity. This is known as the deep water cycle, which is separate from the water cycle we're familiar with at the surface. Knowing how this cycle works, as well as knowing how much water is in the mantle, is important for comprehending Earth's geological activity. For example, water can have a direct influence on the explosiveness of an erupting volcano, as well as affect seismic activity. We can't directly observe this deep water, however, so we have to wait until evidence of the water comes to us. This typically occurs in the form of diamonds with inclusions that formed in the extreme heat and pressure of the planet's interior. The research team studied the Botswana diamond in detail and found 12 mineral inclusions and a cluster of milky inclusions. They used micro-Raman spectroscopy and X-ray diffraction to probe the inclusions to determine their nature. Because ringwoodite decomposes into ferropericlase and bridgmanite ($MgSiO_3$, which becomes enstatite at the lower pressures closer to the surface), their presence in the diamond indicates it formed at depth before emplacement in the crust. In addition, the hydrous phases of the ringwoodite and other minerals in the diamond suggested that the environment in which the diamond formed was very wet. Evidence of water at the transition zone is not new, but it hasn't been sufficient to gauge how much water occurs there. It could indicate the occurrence of a small, localized pocket of water, but the team believes the evidence from this diamond indicates an abundance of water. Upper-mantle diamonds are often associated with the presence of fluids, but super-deep diamonds with retrogressed mineral assemblages similar to the one found in the Botswana diamond rarely have been found to contain hydrous minerals. Although previous ringwoodite findings suggested local water enrichment at the mantle transition zone, the ringwoodite with hydrous phases the team studied, characteristic of a hydrous peridotitic environment at the transition zone boundary, indicates a more broadly hydrated transition zone down to and across the 410-mile discontinuity. Previous research had also discovered that a lot more water is seeping into the deep Earth than had been previously thought. Now we might actually know where it's all going.

https://www.sciencealert.com/diamond-from-660-kilometers-below-earths-surface-reveals-a-water-rich-environment

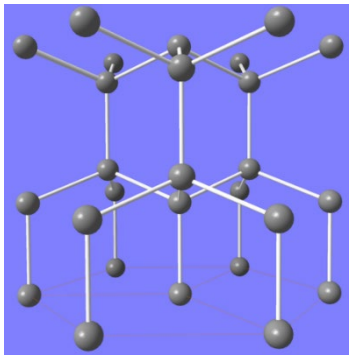


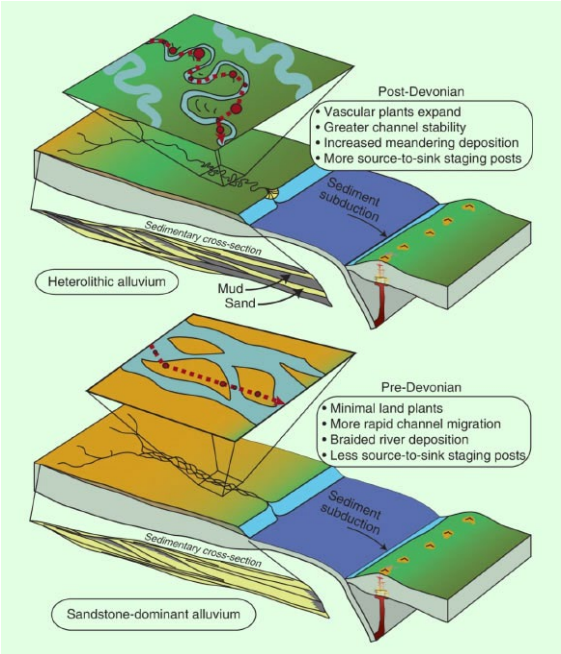
Diagram of the crystal structure of Lonsdaleite.

And speaking of diamonds, we all know from our Physical Geology class that diamond is the hardest material in the world, right? Well, not anymore! First, scientists calculated that a material called wurtzite boron nitride (w-BN) that exists only in small amounts in nature has a greater indentation strength than diamond. Then they calculated that the equally rare mineral lonsdaleite, is even stronger, and 58% stronger than diamond, setting a new record. Lonsdaleite is also called hexagonal diamond because its crystal structure of carbon atoms is hexagonal rather than cubic like diamond, allowing for a much stronger structure. When meteorites containing graphite strike the Earth, the immense heat and stress of the impact transforms the graphite into diamond, but retains graphite's hexagonal crystal lattice. Lonsdaleite was first identified in 1967 from the Canyon Diablo meteorite, the one that created Meteor Crater in Arizona. There, it occurs as microscopic crystals associated with ordinary diamond. Lonsdaleite also was found recently in meteorites that landed

in Africa. The meteorites are thought to have come from a dwarf planet, though scientists aren't exactly sure from which planet they came. Space has been throwing a lot of what we thought we knew into disorder lately. The James Webb Space Telescope, which is circling around a point in space known as the Sun–Earth L_2 Lagrange point, about 930,000 miles beyond Earth's orbit around the Sun, has been baffling astronomers and cosmologists with its discoveries, but it is helping us learn more about our universe. Now that Lonsdaleite has been found in more than one meteorite, scientists will be looking for more. And since we know that there is a mineral stronger than diamond, it makes one wonder what else might be out there waiting to be discovered. What other minerals might await us on the exoplanets James Webb is observing?
https://www.msn.com/en-us/news/technology/scientists-discovered-a-mineral-thats-even-stronger-than-diamond/ar-AA126pKO?li=BBnb7Kz

also see Frondel, C. and Marvin, U. B., 1967, Lonsdaleite, a new hexagonal polymorph of diamond. Nature, v. 214, no. 5088, p. 587–589.

Despite what you might think about the superiority of humanity, plants are actually the dominant kingdom of life on Earth. Plants account for 450 gigatonnes (gT) of the 550 gT of total living biomass, and they have successfully colonized 84% of the surface area of the presently subaerially exposed continental crust. Curiously, Earth's status as a "green planet" is very recent, geologically speaking. And other than some mm-thick microbial mats, land "vegetation" was nonexistent for about 90% of Earth history. The evolution of land plants occurred approximately 430 million years ago during the Silurian Period when all the landmasses were part of the supercontinent Pangaea. Thanks to them, Earth's biosphere transformed; they caused basic changes to river systems, influencing meandering rivers and muddy floodplains, and creating thicker soils. This was due to the development of plant rooting systems that helped produce huge amounts of mud by breaking down rocks, as well as stabilizing river channels that sequestered the mud for long time periods. Earth's surface and deep interior are linked by plate tectonics; rivers



Schematic model of fluvial systems both before and after the evolution of land plants.

transport sediment into the oceans where they get dragged into the Earth's mantle by plate subduction. There, the sediment gets melted to form new rocks. And when these rocks crystallize, they trap traces of their past history. Since the surface and interior of the planet are related through this deposition/tectonic process, some scientists think the evolution of the biosphere and sedimentary rocks should be regarded as a penecontemporaneous shift in the composition of the continental crust. The evolution of plants should have dramatically slowed down the delivery of mud to the oceans, which should be preserved in the rock record. In order to test this hypothesis, researchers from the UK recently assessed the isotopic signatures of zircons formed at subduction zones. They studied a database of over 5,000 zircon crystals formed in magmas at subduction zones. These "time capsules" preserve fundamental information on the chemical conditions that occurred on Earth when they crystallized. The researchers discovered convincing support for the idea that a dramatic shift occurred in the composition of rocks making up Earth's continents, a shift that coincided almost exactly with the onset of land plants. They also found the chemical characteristics of zircon crystals created at that time seem to indicate a noteworthy deceleration of sediment transfer to the oceans as they had hypothesized. Thus, they showed that the rise of

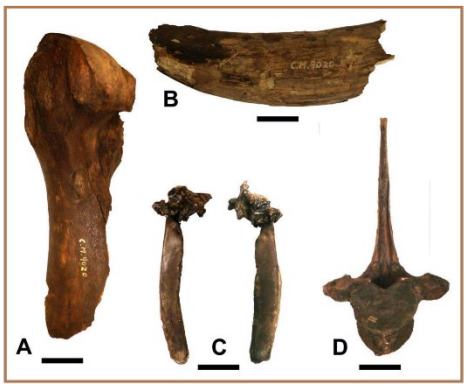
vegetation changed not only the surface of the Earth, but also the dynamics of melting in Earth's mantle.

https://www.sci.news/othersciences/geoscience/land-plants-continental-crust-composition-11151.html

Some items of interest

New research by John A. Harper and Albert D. Kollar. Geology of a Former Pleistocene Bog in Bridgeville, Allegheny Co. Pennsylvania was published in Pennsylvania Geology Fall 2022. The Pittsburgh Geological Society Field Trip September 7, 2019 first reported some of these findings, Stop 5, p. 44.

Historic photograph of a mastodon tusk (CM 11002) that John Clouse found at Sharpsburg on May 3, 1909. The tusk was once on display at the Carnegie Museum of Natural History, but it now resides in the Little Bone Room of Pleistocene Fossils, out of sight of museum visitors. CM, Carnegie Museum. *(Pennsylvania Geology, Fall 2002)*.



Some of the mastodon bones found in the Bridgeville peat bog (Allegheny County, Pa.) and now in the collections of the Carnegie Museum of Natural History (CM).
A. Lower left foreleg, CM 9020.
B. Part of one tusk, CM 9020.
C. Two ribs, CM 9156.
D. A vertebra, CM 9161. Scale bars = 10 cm. *(Pennsylvania Geology, Fall 2002)*.

Albert D. Kollar reports that two Carnegie Museum building stones were accepted in October as Geoheritage Stones by the International Commission on Geoheritage. There are now three Geoheritage Stones incorporated into the Carnegie Complex of 1895 and 1907, an historic landmark building recognized for its architecture. The three interior stones are Carrara Marble of Italy (Cenozoic), the Connemara Marble of Ireland (Ordovician), and Échaillon Limestone of France (Cretaceous). Two additional building stones await a vote by the IUGS commission for Geoheritage status, the Berea Sandstone of Berea, Ohio (Devonian) used as exterior cladding and Holston Limestone of Knoxville, Tennessee (Ordovician) used in interior floors and stairways. There is one other Geoheritage Stone of note at the Carnegie. Larvikite of Permian age from Norway was used in the interior and exterior of the Carnegie Museum of Art building built in 1974.

Albert
Director At Large
PGS Board Member

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WEBSITE OF THE MONTH

https://www.americangeosciences.org/critical-issues/faq/what-are-rare-earth-elements-and-why-are-they-important

Fun Fact Having Nothing to Do with Geology

A puppy's cuteness, as perceived by humans, peaks at around eight weeks, which is about the same time that their mothers finish weaning them.

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If you know of anyone who is not a member who would like to become one, let them know that they just need to go to https://pittsburghgeologicalsociety.org/new-membership-instructions.html and fill in the boxes marked with that ubiquitous red asterisk. And again, they can pay through the website.

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