



Atlanta Geological Society Newsletter

ODDS AND ENDS

Dear AGS members,

As we are halfway through the third month of 2017 I am glad to see the new officers and committee heads are settling into their new rolls. I count myself amongst those folks. Jim Ferreira is doing a great job with the newsletter. Do I miss doing it? Yes. But the point was to give someone else the fun and responsibility of performing a very useful function for the Society.

There is one item of pressing business brought to my attention by our Treasurer, John Salvino. As of March 9th, we have only 15 people who have paid their dues. Last year we had about 50 members by the end of April. I know there has been some discussion about enhancing our finances by raising the dues. Dues are our main source of revenue and we can't plan for our year's activities without the confidence of knowing we have a firm financial footing. Our dues are on an annual basis but we may need a formal amendment to the bylaws to codify our long-standing practice of a January 1 renewal date for the dues.

Please take this opportunity to use our new online dues paying process. Just press Ctrl and click <https://squareup.com/store/atlanta-geological-society> It is so easy and we could use your financial support.

I must travel this month so it will be Steven Stokowski, our VP, running the show.

Ben Bentskowski, President
(and not the newsletter editor!)

March Meeting

Join us **Tuesday, March 28, 2017** at the Fernbank Museum of Natural History, 760 Clifton Road NE, Atlanta GA. The meeting/dinner starts at 6:30 pm and the meeting starts approximately 7 p.m.

This month our presentation is: PCE Contaminated Dry Cleaner Site in Georgia, presented by Burton Dixon, P.G. Please find more information and Mr. Dixon's bio on the next page.

This upcoming presentation will work through the investigation and remediation of contaminated groundwater for a facility in the coastal plain of Georgia.

Please come out, enjoy a bite to eat, the camaraderie, an interesting presentation and perhaps discussion on whether the underlying kaolin bed was initially remediated or proved a source of back diffusion for the VOCs.

PCE Contaminated Dry Cleaner Site in Georgia,

Burton Dixon, P.G.,

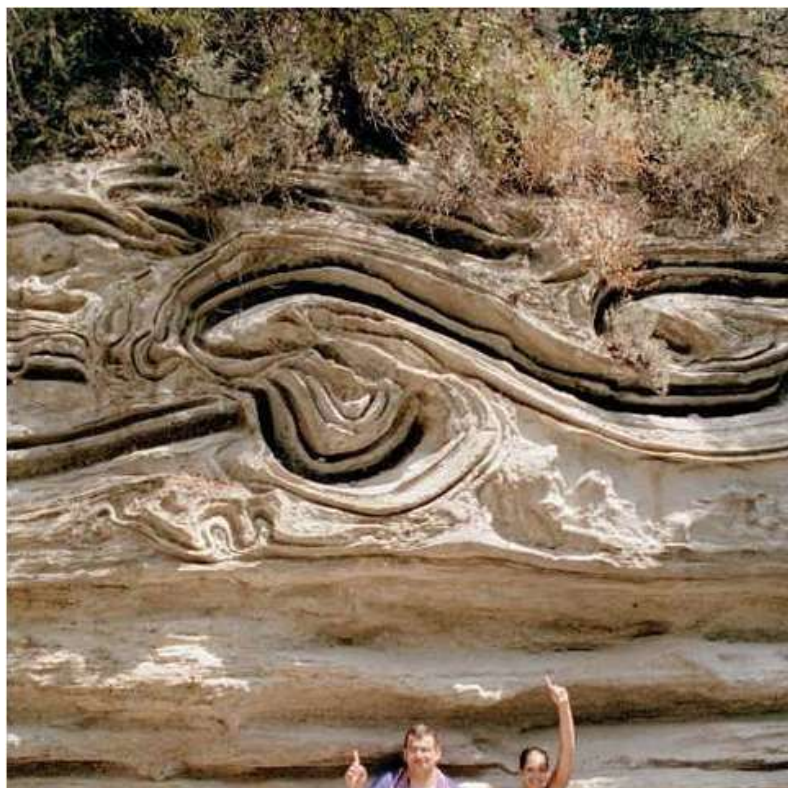
American Environmental & Construction Services, Inc.

Atlanta Geological Society March 28, 2017

Fernbank Museum of Natural History, Atlanta

Burton Dixon received his BS in Geology from West Georgia in Carrollton, Ga in 1986, he earned his Master's in Geology from the University of Mississippi in 1990 and has his PG in several states. After working at the University of Miami, Rosenstiel School of Marine & Atmospheric sciences in oceanography for 5 years, he came to Atlanta in 1996 and has been working in the environmental consultant business ever since.

A dry cleaner facility was located on a site in the Coastal Plain Province of Georgia for approximately 25 years. The heterogeneous soils on the site consisted of sandy clays with a confining kaolin layer at approximately 30 feet below ground surface. This site was listed on the Hazardous Site Inventory (HSI) in November 1998. The objectives of the remediation were to remediate the soils and groundwater to non-residential standards, Type 4 RRS and get the site delisted from the HSI. An air stripper was installed on site and ran for 10 years with good results but the client wanted a more aggressive approach. In-situ chemical oxidation (ISCO) was then used and after six ISCO events the site is in the process of being delisted.



Pyroclastic Flows on Ischia

This pyroclastic flow deposit is located in Poseidon's Gardens, near Citara on the island of Ischia, Italy. Ischia, just off the coast from Naples and notorious Mt. Vesuvius, is dominated by Mt. Epomeo. This deposit indicates the violent nature of pyroclastic flows and the turbulence and deformation possible within these volcanic features. These soft volcanic layers were deposited about 10,000 years ago and deformed as the flow slid down the side of the mountain, or possibly as the soft sediments were covered by a more viscous lava flow during the same eruption.

<http://epod.usra.edu/blog/2017/03/archive-pyroclastic-flows-on-ischia.html>

Zealandia: Earth's Hidden Continent

GSA TODAY

Nick Mortimer, Hamish J. Campbell, Andy J. Tulloch, Peter R. King, Vaughan M. Stagpoole, Ray A. Wood, Mark S. Rattenbury, Rupert Sutherland, Chris J. Adams, Julien Collot, Maria Seton <https://www.geosociety.org/gsatoday/archive/27/3/article/GSATG321A.1.htm>

Article, pp. 27–35 | [Abstract](#) | [PDF](#) (450KB)

Abstract

A 4.9 Mkm² region of the southwest Pacific Ocean is made up of continental crust. The region has elevated bathymetry relative to surrounding oceanic crust, diverse and silica-rich rocks, and relatively thick and low-velocity crustal structure. Its isolation from Australia and large area support its definition as a continent—Zealandia. Zealandia was formerly part of Gondwana. Today it is 94% submerged, mainly as a result of widespread Late Cretaceous crustal thinning preceding supercontinent breakup and consequent isostatic balance. The identification of Zealandia as a geological continent, rather than a collection of continental islands, fragments, and slices, more correctly represents the geology of this part of Earth. Zealandia provides a fresh context in which to investigate processes of continental rifting, thinning, and breakup.



A deliberately chosen color ramp on a satellite gravity-derived bathymetry map provides an excellent visualization of the extent of continental crust (Fig. 2). The approximate edge of Zealandia can be placed where the oceanic abyssal plains meet the base of the continental slope, at water depths between 2500 and 4000 m below sea level. The precise position of the foot of the continental slope around Zealandia was established during numerous surveys in support of New Zealand's Law of the Sea submission.

Zealandia is everywhere substantially elevated above the surrounding oceanic crust. The main difference with other continents is that it has much wider and deeper continental shelves than is usually the case. Zealandia has a modal elevation of ~1100 m and is ~94% submerged below current sea level. The highest point of Zealandia is Aoraki–Mount Cook at 3724 m.

World's Lakes Are Much Shallower Than Thought, Mathematical Analysis Suggests

NEW ORLEANS, LOUISIANA—The world's lakes are only about two-thirds as deep, on average, as previously thought, researchers reported here this week at a meeting of the American Physical Society. If correct, the finding could help climate scientists more accurately model global climate change, as shallower lakes generate more heat-trapping methane gas.

Satellites show roughly 100 million lakes with areas greater than a hectare dotting the Earth surface. All together, they cover more than 30 billion hectares, roughly 2% of planet's land surface. But estimating the depths of these bodies of water is a trickier task. Lake depth varies widely: The famed Loch Ness in Scotland is on average 132 meters deep, more than four times as deep as North America's Lake Erie, even though Erie is 4500 times as large in area. Scientists typically infer a lake's depth from the local topography—that is, the slopes of the surrounding land—says B. B. Cael, an oceanographer at the Massachusetts Institute of Technology in Cambridge and lead author on the new study. Estimates for the total volume of Earth's lakes range from 160,000 to 280,000 cubic kilometers, Cael says.



With Adam Heathcote, an ecologist at the Science Museum of Minnesota in Marine on St. Croix, and David Seekell, an environmental scientist at Umeå University in Sweden, he first developed a model that could explain the observed distribution of lake areas around the world. Using data from multiple surveys, Cael found that the number of lakes in a given area falls as the area increases according to a particular mathematical relationship known as a power law. Put simply, small lakes come in bunches, and big ones are rare: There are only 1/100 as many lakes with an area of 10 hectares as there are with an area of 1 hectare, only 1/100 as many lakes with area of 100 hectares as there are with 10 hectares, and so on. That power law and additional data suggest researchers have underestimated the number of small lakes, so Cael and his colleagues ended up with a slightly higher estimate of the total area of the world's lakes.

To estimate volumes and depths, Cael then invoked a mathematical model of Earth's topography. He assumed that Earth's surface has a fractallike symmetry that makes it approximately "self-affine." In other words, no matter how much one zooms in or out, the distribution of mountains and valleys will be statistically identical if all the heights are stretched by a particular factor. Specifically, several topographic studies show that if you zoom in on the landscape by a factor of 10, then you need to adjust the heights by a factor of 2.5, Cael says. (Studies also suggest Mars is roughly self-affine, with the same scale factor of 2.5.)

World's Lakes Are Much Shallower Than Thought, Mathematical Analysis Suggests (Continued)

That relationship then enables researchers to infer, statistically, the volumes and depths of lakes from their areas. “We assume that the lake cannot substantially change the underlying topography,” he says. Cael found the total volume of Earth’s lakes to be 199,000 cubic kilometers—on the lower end of previous estimates. Strikingly, the model **also suggests the average depth of Earth’s lakes is 42 meters**, significantly lower than the previous 62-meter low estimate.

If Earth’s lakes are, on average, significantly shallower than previously thought, that observation could have consequences for understanding climate change, Cael says. Microbes that don’t require oxygen live at the bottom of lakes and produce methane. If lakes are shallower, more of that heat-trapping gas can bubble up to the surface and into the atmosphere. Current methane budgets suggest lakes produce about as much methane as the oceans and roughly half as much methane as the world’s landfills, but that number may have to be revised higher.

Although it involves a mathematical model, the study’s strength is that it sticks closely to the data, says Mary Silber, an applied mathematician at the University of Chicago in Illinois. “I liked the care with which he is just trying to collect the data and see if it can be explained with something quite simple.”

http://www.sciencemag.org/news/2017/03/world-s-lakes-are-much-shallower-thought-mathematical-analysis-suggests?utm_campaign=news-weekly_2017-03-17&et rid=17048804&et cid=1222268

Melting Glaciers Around Mount Everest May Be Forming Killer Lakes

Of the roughly 198,000 glaciers on the planet, more than a quarter are found in the Himalayas. But even this frigid expanse of ice and snow—home to nine of the world’s 10 highest peaks—is reeling from climate change. Many Himalayan glaciers are receding—and a new study of 32 glaciers around Mount Everest has found that those terminating in lakes have lost more ice mass than landlocked glaciers. That’s a worrying trend because many glacial lakes form behind unstable debris dams that are poised to collapse and send disastrous floods hurtling down valleys.

Himalayan glaciers are losing ice mass because of decreased snowfall and higher average air temperatures that melt existing ice. “The landscape is primed for lake development,” says Owen King, a glaciologist at the University of Leeds in the United Kingdom, who led the study. As meltwater lakes swell, the risk of a breach heightens. According to Joseph Shea, a glacier hydrologist at the University of Saskatchewan in Saskatoon, Canada, who was not involved in the research, “Bigger lakes may increase the risk of catastrophic dam failure.”

Just that happened in 1985, when a debris dam at Dig Tsho, a glacial lake in eastern Nepal, burst, spilling millions of cubic meters of water on the village of Ghat. The flooding destroyed houses, bridges, and a new hydroelectric plant. To avert a similar disaster, the Nepalese government last year drained part of Imja Tsho, one of the fastest-growing glacier lakes in the country.

Now, King and his collaborators have used satellite data to reveal how nine glaciers terminating in lakes and 23 terminating on land in Nepal and Tibet changed over 15 years. Armed with digital elevation maps obtained in 2000 and 2015 and images of the glaciers themselves, the team compared how the ice mass, ice area, and height of the glaciers changed. They found that the glaciers melting into lakes had lost 32% more ice mass per year than land-terminating glaciers, they report this month in *The Cryosphere*. The lake-terminating glaciers had also lost more height and area than the landlocked glaciers.

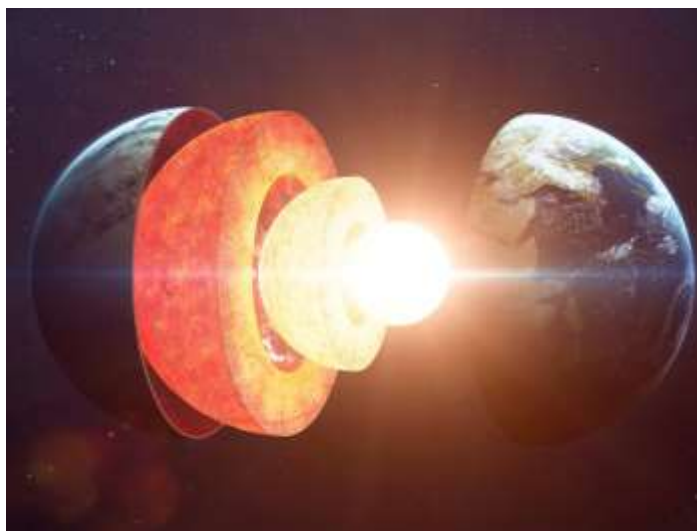
King’s team believes lake water erodes the underside of glaciers, causing them to calve icebergs. That process would efficiently remove ice mass, they suggest. But other scientists say the issue isn’t settled. “It’s still unclear why lake-terminating glaciers are losing more mass than land-terminating glaciers,” says Patrick Wagnon, a glaciologist at the French National Research Institute for Sustainable Development in Marseille, who was not involved in the study.

<http://www.sciencemag.org/news/2017/02/melting-glaciers-around-mount-everest-may-be-forming-killer-lakes>

Scientists Are Beginning To Rethink Where Earth's Water Came From

Geoscientists continue to debate two competing theories. One suggests that Earth's water might have been captured from asteroids and comets that collided with the planet. But recent research has strengthened the case for the other theory that water was always present in the rocks found in the Earth's mantle and was gradually released to the surface through volcanoes. Working out which mechanism was more important would not only give us a better understanding of the Earth's history but also help us in the search for other planets that could support life.

In 1974, scientists discovered that the Earth's mantle contained more precious metals such as platinum than you would expect. These elements are naturally attracted to iron and so the vast majority of them were pulled into the planet's iron core early in its history. This led to the idea that asteroids striking the Earth soon after its tumultuous infancy delivered an extra layer of material. This "late veneer" may have included not just precious metals but also "volatile" substances, such as carbon and water, which are known to exist on a type of asteroid called carbonaceous chondrite.



But recent research has made this captured water theory seem much less likely. In January 2017, a study showed that the type of ruthenium (one of those iron-loving metals) in the Earth's mantle has a different atomic signature to that found in common asteroids from the outer solar system. That suggests the late veneer came from the inner solar system, where volatile substances are rare – and that these asteroids therefore weren't the main source of water on Earth. This adds to other research that suggests water was abundant on Earth before the late veneer is thought to have arrived. For example, there is various evidence that the oldest terrestrial minerals (zircon) crystallized from magma sources interacting with liquid water. These minerals are between 4.1 billion and 4.3 billion years old, but the final late veneer is most commonly thought to have been delivered around 3.9 billion years ago.

What's more, just because an asteroid carries water doesn't mean it can successfully deliver this cargo to Earth. In fact, scientists now believe that the Earth may have lost mass rather than gained it during early violent asteroid impacts, a process known as collisional or impact erosion. This is still an unproven theory but a recent study of the Sudbury impact crater in Canada revealed evidence that collisions had vaporized most of the volatile metal lead. This implies that the more volatile species such as water would also have been lost to space in the impact.

A final clue that the planet's oceans may have formed very early on is that there is more chlorine on Earth than you would expect. The early presence of liquid water on the planet would have given the chlorine something to dissolve into and so help prevent it from being lost to space. Finally, unlike planetary scientists, geochemists have long argued that the Earth's oceans don't come from captured icy comets because they contain different amounts of "heavy" hydrogen.

Scientists Are Beginning To Rethink Where Earth's Water Came From

(Continued)

All this evidence suggests that the Earth's surface water or "liquid hydrosphere" actually accumulated by degassing from within the planet. Water is stored in the Earth's mantle in the form of hydroxyl groups (one hydrogen and one oxygen atom) trapped within minerals such as ringwoodite. When the mantle rocks melt, the water dissolves into the magma. As the magma rises towards the surface and cools, pressure is reduced, crystals form and the water is released and emitted as vapor through volcanoes. With this mechanism, water from great depth can be degassed to the surface.

Pioneering experimental work showed that minerals at depths of 150 km to 200 km (93 mi to 124 mi) could contain water – but, more recently, experiments, modeling and seismic data suggested that water might also be found as deep as 400 km to 660 km (249 mi to 410 mi) below the surface. Recent data from scientists studying how diamond crystals form deep underground suggests that water might be stored even further down. This new evidence from actual deep mantle minerals certainly makes the idea that the Earth's surface water came from depth seems more likely.

But it is important to understand that water can also be recycled back into the mantle. This means there is a balance between the water in the oceans and that stored up in the mantle. We can only speculate how much water might still be locked up at these great depths. What we do know is that the average level of the sea surface relative to the continental land has remained relatively constant across nearly four billion years. This suggests a constant cycle of water emerging from and being absorbed back into the mantle has significantly helped life to continue throughout its history on this planet.

<http://www.businessinsider.com/earth-oceans-comets-or-volcanoes-2017-3?amp>

Stunning Close-up of Saturn's Moon, Pan, Reveals a Space Empanada



Astronomers have long known that Pan, one of Saturn's innermost moons, has an odd look. Based on images taken from a distance, researchers have said it looks like a walnut or a flying saucer. But now, NASA's Cassini probe has delivered stunning close-ups of the 35-kilometer-wide icy moon, and it might be better called a pan-fried dumpling or an empanada. Pan orbits Saturn in a gap in the planet's rings and pulls material from them, so the ridge around it likely started accumulating soon after the moon formed, researchers say. The new images are only hours old (March 9, 2017, 23:30), so scientists haven't yet had time to estimate how wide and tall the ridge are. If material in the ridge is still loose, rather than somehow fused together, the ridge can maintain its steepness only because the moon's gravity is so low. The latest pictures were obtained as Cassini conducts its final (and riskiest) flybys past Saturn's moons and rings before it blazes into the planet's atmosphere later this year.

<http://www.sciencemag.org/news/2017/03/space-empanada-frozen-ridge-around-saturn-s-moon-pan-collected-planet-s-rings>

An Explosion of Never-Before-Seen Minerals Could Mark the Dawn of a New Geological Epoch

Scientists have identified a sudden explosion of mineral diversity on the surface of our planet that would not exist if it weren't for humans, adding weight to the argument that we're living in a new geological epoch - the Anthropocene.

A new study has found that the incredible upsurge of new minerals around the time of the industrial revolution led to the unprecedented diversification of crystals on Earth, eclipsing even the Great Oxidation Event 2.3 billion years ago as the "greatest increase in the history of the globe". "This is a spike of mineral novelty that is so rapid - most of it in the last 200 years, compared to the 4.5-billion-year history of Earth. There is nothing like it in Earth's history," one of the team, Robert Hazen from the Carnegie Institution for Science.



Hazen and his team analysed the 5,208 minerals on Earth that are officially recognised by the International Mineralogical Association, and found that 208 of them would not exist if it weren't for human activity. These human-triggered minerals include chalconatronite, a rare copper mineral that crystallises as a bright blue crust on ancient Egyptian bronze artefacts, and andersonite, a uranium-laced mineral with a fluorescent green or yellow glow that forms on the walls of mine tunnels. The bronze-hued abhurite was discovered on the wreck of the *SS Cheerful*, which sank off the coast of Cornwall, England in 1885, and only formed because of a chemical reaction between the salt water and the ship's sunken supply of tin ingots.

Most of the 208 minerals triggered by humanity came about thanks to mining, while six were found on the walls of smelters, three in a geothermal piping system, and four on prehistoric sacrificial burning sites in the Austrian mountains. Many other new minerals could also be forming in our giant waste dumps, encrusting old batteries and electrical appliances like never before, the team suggests.

"TVs have all these exotic phosphors they use, and magnets and all sorts of high-tech materials. When you start hydrating and oxidising them, you're going to start finding a lot of exotic new materials." The list did not include new minerals that have been deliberately synthesised by humans, such as those produced in magnets, batteries, and synthetic gemstones, as the 'true' definition of a mineral according to the International Mineralogical Association is that it must occur "naturally".

Over the course of Earth's history, the team found that most minerals on Earth appeared very gradually during the

An Explosion of Never-Before-Seen Minerals Could Mark the Dawn of a New Geological Epoch (Continued)

Great Oxidation Event, which began roughly 2.3 billion years ago, and could have lasted as long as until 1 billion years ago. The event saturated Earth with atmospheric oxygen for the first time, thanks to an explosion of photosynthetic bacteria, and the minerals on the surface increased from just over 2,000 varieties to more than 4,000.

While this event gave rise to around two-thirds of the 5,208 mineral types officially recognised today, that gradual build was nothing compared to the sudden burst of diversity that's occurred over the past few centuries. Since the mid-1700s, the diversity of minerals on Earth has exploded faster than ever before, the team noting the "blazing pace" that humans triggered over the past 250 years - especially when compared to the slow burn of the Great Oxidation Event.

They say this unprecedented diversification is the fastest rate of new mineral production in Earth's history, and a clear marker of a new geological epoch caused by humans - the much-debated Anthropocene. The Anthropocene has yet to be officially recognised, but scientists have been arguing for years that human influence on the planet has been so dramatic, it will be clearly defined in Earth's strata - layers of sedimentary rock or soil that delineate major geological events in our planet's history. Hazen and his team now say that this explosion of new minerals has to be considered by the International Commission on Stratigraphy - the group that will ultimately decide whether or not to reorganise the Anthropocene - as a serious marker of a new epoch.

"That's really I think the most important factor in deciding whether or not the Anthropocene is a new geological time period - the fact that we have created these materials, these crystals, that are incredibly diverse and beautiful and they persist through billions of years,". "They are going to be for ever on Earth - a distinctive marker layer that makes our time different from any other time in the preceding 4.5 billion years." Previous arguments for the Anthropocene suggest that humans cut short the 11,700-year-old Holocene epoch in 1950, when nuclear tests created a new stratum in Earth's surface. Or it could have started in 1610, when a dramatic drop in atmospheric CO2 levels, triggered by the arrival of Europeans in the Americas in 1492, was captured in the Antarctic ice-core records. This new study is more solid evidence of human influence on the planet, Hazen and his team argue.

"If you're a geologist who came back 100,000 years or a million or a billion years from now ... you would find amazing mineralogical evidence of a completely different time," Hazen told *The Washington Post*. We'll have to wait and see if their argument is strong enough. The research has been published in *American Mineralogist*.

<http://www.sciencealert.com/an-explosion-of-never-before-seen-minerals-could-mark-the-dawn-of-a-new-geological-epoch>

Rocks Made Of Plastic Found On Hawaiian Beach

Geologist Patricia Corcoran of the University of Western Ontario in London, Canada, and Charles Moore, captain of the oceanographic research vessel *Alquita*, stumbled upon these rocks on the beach of the Big Island of Hawaii. These stones, which they've dubbed "plastiglomerates," the team reports this month in *GSA Today*. Although anywhere there is a heat source, such as forest fires or lava flows, and "abundant plastic debris," Corcoran says, "there is the potential for the formation of plastiglomerate." When the plastic melts, it cements rock fragments, sand, and shell debris together, or the plastic can flow into larger rocks and fills in cracks and bubbles.

Corcoran and her team canvassed Kamilo Beach on the Big Island for more of the rocks and found plastiglomerate in all 21 sites they surveyed. She says people have already found plastiglomerate on another Hawaiian island, and she expects there to be much more on coastlines across the world. Plastiglomerate is likely well distributed, it's just never been noticed before now, she says.

Rocks Made Of Plastic Found On Hawaiian Beach (Continued)



A sample of plastiglomerate, collected on Kamilo Beach in Hawaii.

The discovery adds to the debate about whether humanity's heavy hand in natural processes warrants the formal declaration of a new epoch of Earth history, the **Anthropocene**, says paleontologist Jan Zalasiewicz of the University of Leicester in the United Kingdom, who was not involved in the study. Plastics in general are so pervasive that they've been documented in a number of surprising places, including ingested in wildlife and on the sea floor. The mass of plastic produced since 1950 is close to 6 billion metric tons, enough to bundle the entire planet in plastic wrap. Combine plastic's abundance with its persistence in the environment, and there's a good chance it'll get into the fossil record, Zalasiewicz says. "Plastics, including plastiglomerates, would be one of the key markers by which people could recognize the beginning of the Anthropocene."

Geologist Philip Gibbard of the University of Cambridge in the United Kingdom says he imagines that plastics might "revert back to a source of oil from whence they came, given the right conditions of burial." But Zalasiewicz and Corcoran say that isn't true for all the plastic. Some of the material can be preserved as a thin carbon film, much like the way fossil leaves are preserved. Zalasiewicz says that in some rare cases, in that etch of carbon "you may well be left the shape for a flattened plastic bottle."

<http://www.sciencemag.org/news/2014/06/rocks-made-plastic-found-hawaiian-beach>

Scientists May Have Just Discovered the World's Oldest Fossils

In a new study, a team of scientists announced it has discovered the world's oldest fossils, dating back some 3.77 billion years (and possibly as far back as 4.28 billion years). The remarkable find, detailed yesterday in the journal *Nature*, is comprised of a series of microscopic filaments and tubes that researchers believe were formed by bacteria that thrived on iron. If proven true, the fossils would be the oldest direct link to life on Earth—but not everyone is on board with the stunning discovery.

The team of international researchers, led by Dominic Papineau and Matthew Dodd from University College London, discovered the specimens (embedded in quartz) in the remote Nuvvuagittuq Supracrustal Belt, or NSB, along the eastern shore of the Hudson Bay, near Quebec, Canada. The NSB has long been known to researchers as the home of some of the oldest sedimentary rocks in the world, including some dating back to just 100 million years after Earth was formed, some 4.65 billion years ago.

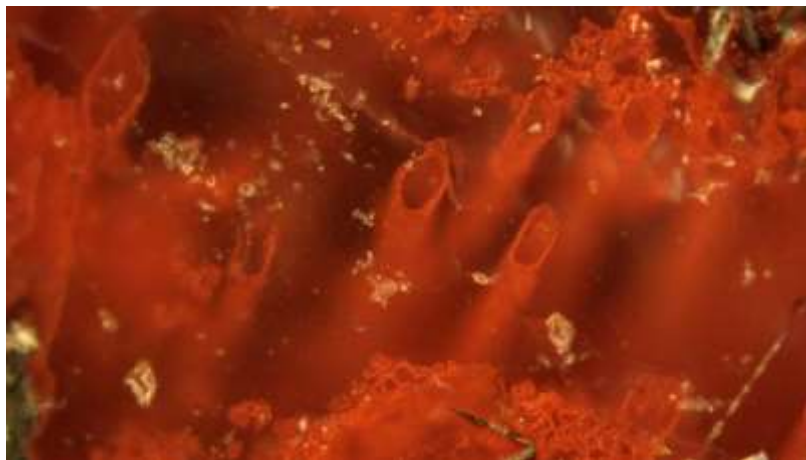
The region was also once part of an iron-rich, deep sea hydrothermal vent system, the researchers said in a statement, providing a fertile ground in which the bacteria thrived. According to Dodd, "our discovery supports the idea that life

Scientists May Have Just Discovered the World's Oldest Fossils

(Continued)

emerged from hot, seafloor vents shortly after planet Earth formed.” The tiny, wavy, microfossils, made of hematite (a form of iron oxide) and half the width of a human hair, are similar to other iron-oxidizing bacteria that have been found near hydrothermal vents in California and Norway, although those examples have been found to be much younger (450 million years and 180 million years old), according to Live Science.

The oldest fossils found prior to this may have dated back some 3.5 billion years and were discovered in western Australia in 2013. Another contender for the crown may be fossils found in Greenland last summer. Researchers there dated their find to 3.7 billion years ago, but there has been fierce debate since then about the accuracy of the results, in part due to the difficulty in accurately dating when the rocks the fossils were found in were formed.



As with the Greenland find, the NSB study has been challenged by scientists, some of which cast doubt over whether the fossils were really fossils at all. As geologist Martin J. Van Kranendonk told the New York Times, the filaments found in Canada may be “dubiofossils,” with no biological origins. As NBC News reported, it’s also possible that the tubes could have been formed over time, as the sedimentary rocks compressed and shifted along with the Earth’s tectonic plates. Other scientists have pointed to their size, much larger than any previously dated fossils yet discovered, as an indicator that the filaments must be much younger, as it’s believed that early conditions on Earth did not provide enough oxygen to support rapid growth of bacteria.

The team from the NSB study, however, believes it has ruled out any possible non-biological origins for the fossils. Utilizing electron microscopes, ion beams and laser imaging, they examined the mineral makeup of the fossils, which showed traces of biological matter and gasses, the aftereffect of putrefying organic material. That finding does have its supporters, among them David Wacey, a researcher at the University of Western Australia who told the New York Times that for him the evidence is a “pretty convincing biological scenario.”

While the debate continues, the NSB team is already looking ahead towards what insight might be gleaned from their discovery, both here on Earth and in space. If the filaments do indeed date back to 3.7 billion years (or even far earlier), that would indicate that some forms of life emerged on Earth much earlier than previously thought—and under much more primitive conditions. As Matthew Dowd noted, “The process to kick-start life may not need a significant length of time or special chemistry, but could actually be a relatively simple process to get started.” And that, he said, means conditions on other planets like Mars, may have been able to support living organisms as well.

<http://time.com/4687644/canada-worlds-oldest-fossil/>

Exquisitely Preserved Fossil Deposit A Window On Early Life On Land

How life made the move onto land is one of the big questions for palaeobiologists. The physiological challenges were immense, and affected most facets of life. Organisms needed to adapt how they gained water (and prevented themselves drying out), how to obtain nutrients, how to exchange gases with the atmosphere, how to support and move a body without water buoyancy, not to mention reproducing out of water.

Life doesn't have a grand plan, and terrestrialisation (as the process is known) was a messy, incremental process, with different organisms adapting to life on land at different paces. It's a bit like going camping with a gang of friends. There will be the keen, pioneering types who like to get there early, set up camp and resolve any problems. Then there's the late-comers, who roll up with the beer when most of the hard work has been done. The popular image of a lobe-finned fish lolloping up a beach to conquer the land is attractive, but there's plenty that happened on land before the tetrapods joined the party.



Plants growing close to a geothermal pool at Yellowstone National Park

There are clues to the earliest stages in the timeline of the move onto land. Microbial mats had probably been sliming the margins of water bodies since the Precambrian, more than 500 million years ago. Fossil soils (known as palaeosols) from about 460 million years ago suggest that organic matter was being deposited and then recycled by microbes, arthropods were burrowing, and clumps of plants were even stabilising mature soils (but with no direct evidence of the plants themselves). Microfossils preserved in near-shore sediments also tell us that plants were already producing spores (an adaptation to life on land), and dispersed plant tissues show that early land plants had already evolved by that point.

We are very lucky to have a snapshot of the earliest ecosystems on land from just over four hundred million years ago, in an exquisitely preserved deposit known as the Rhynie Chert, from Rhynie, a village in Aberdeenshire. A scientific meeting last week at the Royal Society in London brought together a global community of Rhynie Chert researchers to share their collective knowledge, on the centenary of the first scientific publication on the Chert by palaeobotanists Kidston and Lang.

Four hundred million years ago, Scotland was sitting just south of the Equator, and the upland area that became Rhynie would have looked similar to today's Yellowstone Park. Hot springs rich in minerals would have dominated the landscape. We know from modern equivalents that the vent pools themselves would have been too hot and alkaline to harbour and preserve life, but as you move away from the vents, out towards cooler, less alkaline (but still inhospitable) geothermal wetlands, you see a sequence of different organisms making the best of an extreme habitat.

Exquisitely Preserved Fossil Deposit A Window On Early Life On Land

(Continued)

The wonderful thing about the geothermal setting at Rhynie is that the precipitation of silica from the hot spring water rapidly preserved organisms in life position, and with cellular detail.



The Rhynie Chert: a snapshot of the earliest ecosystems on land from just over four hundred million years ago.

Preserved in those precious lumps of chert are everything from bacteria, fungi and algae, to early land plants and their spores, and animals including nematode worms, arachnids, centipedes, springtails, silverfish and harvestmen. The oldest known lungs belong to *Palaeocharinus*, a spider-like trigonotarbid. Another arachnid, the harvestman *Eophalangium*, briefly held the record for the world's oldest known penis. The Rhynie Chert also preserved aquatic arthropods in exquisite detail, allowing the detailed structure of crustacean mouthparts to be studied to below a thousandth of a millimetre. Painstaking work using stacks of images to reconstruct larval crustaceans from the nearby (and contemporaneous) Windyfield Chert has resulted in a remarkable amount of knowledge about life within the hydrothermal waters, as well as above them.

The information that we have been able to glean about early land plants from the Rhynie Chert is the really astonishing thing. The early land plants at Rhynie formed the equivalent of modern-day 'cryptogamic groundcover': algae, lichens and mosses living in intimate association in the very top-most layer of soil.

Modern spore-producing plants such as mosses, liverworts and even ferns all have life cycles which alternate between a gametophyte form of the plant, with a single copy of the genome and which produces gametes, and, following fertilization, a sporophyte phase with two copies of the genome, which produces and releases spores, from which the gametophyte emerges... and so on. Sporophyte-phase plants from Rhynie such as *Rhynia*, *Aglaophyton* and *Horneophyton*, with root-like rhizoids and naked branching axes (leaves had yet to evolve) were first described a hundred years ago. Remarkably, their equivalent gametophyte forms have all also been identified. In modern spore-producers the emphasis is either on the gametophyte phase (in mosses and liverworts) or on the sporophyte phase (in ferns) but in the Rhynie ecosystem, both phases were independent, free-living plants of similar complexity. This could mean that the Rhynie plants are the sister group to modern vascular plants, the group which includes the ferns and all other 'higher' plants with water-conducting tissues.

Exquisitely Preserved Fossil Deposit A Window On Early Life On Land

(Continued)

Rapid preservation in mineral-rich fluid has even captured near-impossible moments in a plant life cycle: the release of sperm cells from the male gamete (antheridium) from the gametophyte form of *Aglaophyton*, known as *Lyonophyton*. The details of intimate interactions between early plants and other organisms are also captured: mycorrhizal fungi living in symbiosis inside the plant tissues, 400 million years ago, can be discerned.

The biggest and most complex plant from the Rhynie Chert, *Asteroxylon mackiei*, almost has leaves. The plant resembles a modern clubmoss, but its leaf-like structures do not have any of the plumbing expected of true leaves and neither do its root-like rhizoids. *Asteroxylon* does, however, have water-conducting tissues in its stems, and the beautiful cross-sections found in thin sections of Rhynie Chert look uncannily like those of modern clubmosses.

One question which remains after a hundred years of Rhynie Chert research is how typical the ecosystem is for the Early Devonian, 400 million years ago. Hydrothermal wetlands are highly specialised ecosystems today, and a comparison with plant spores found in other rocks of equivalent age suggests that the Rhynie plants may represent the hardcore subset of pioneering early land plants which could survive in such a challenging environment. Exciting experimental molecular work with the modern equivalents to the Rhynie plants (such as the liverwort *Marchantia* and the moss *Physcomitrella*) is approaching the same question from the opposite direction: which genes which have been conserved in these plants are key to understanding how they adapted to life on land.

<https://www.theguardian.com/science/2017/mar/15/exquisitely-preserved-fossil-deposit-is-a-window-on-early-life-on-land-rhynie-chert#img-2>

Upcomming Rock, Mineral and Fossil Shows

May 2017

12-14 MARIETTA, GEORGIA: Annual show; Georgia Mineral Society, Cobb Civic Center; 548 South Marietta Pkwy., SE; Fri. 10-6, Sat. 10-6, Sun. 12-5; Free Admission; The Georgia Mineral Society's 49th Annual Mother's Day Weekend Gem, Mineral, Jewelry, and Fossil Show. Exciting auction Saturday at 1 pm. Door Prizes! Special Door Prize for Students! Win a Great Prize for Yourself and for Your School! ; contact Kathy Wiggins, (770)-375-5907; e-mail: showads@gamineral.org; Web site: www.gamineral.org

June 2017

11-12 TELLUS SCIENCE MUSEUM, CARTERSVILLE, GEORGIA: 100 Tellus Drive, Cartersville, GA 30120. Phone Number (770) 606-5700. Saturday and Sunday 10:00 to 5:00. GEM, MINERAL, FOSSIL, AND JEWELRY DEALERS from across the country will be set up in the Banquet Rooms and outside on the back lawn. You will see rare and exotic jewelry, ancient fossils, and rocks from around the world that you can purchase for your own collection. Many dealers will even honor the Tellus **member** discount, saving you 10% off your purchase!

Fernbank Events & Activities



Wildflower Tours

Dates and Times Vary

Take a guided tour of Fernbank Forest and learn more about the diversity of and how to identify native wildflowers.

[Learn more](#)



Spring EGG-stravaganza

Saturday, April 8, 2017

Welcome spring with opportunities to meet live baby animals, find prize-filled eggs, play fun games and more.

[Learn more](#)



Fernbank Forest Animal Traces Tour

Saturday, April 15, 2017

Enjoy the great outdoors with a Fernbank Museum scientist on a guided tour of Fernbank Forest. Participants will hone their observation skills to find traces of animals throughout the forest and learn more about animal habits. This program is for ages 8 and up and is not suitable for strollers.

[Learn more](#)

FERNBANK MUSEUM of NATURAL HISTORY



Wildwoods and Fernbank Forest

WildWoods features 10 acres of lush woodlands, highlighted by hands-on exhibits for all ages, tree pods suspended in the canopy, a nature gallery, immersive adventures, and meandering trails emphasizing dramatic slopes and stunning views. This interpretive nature experience serves as the new entrance into Fernbank Forest.

[Learn more](#)



Wild Weather

Showing January 28 – May 7, 2017

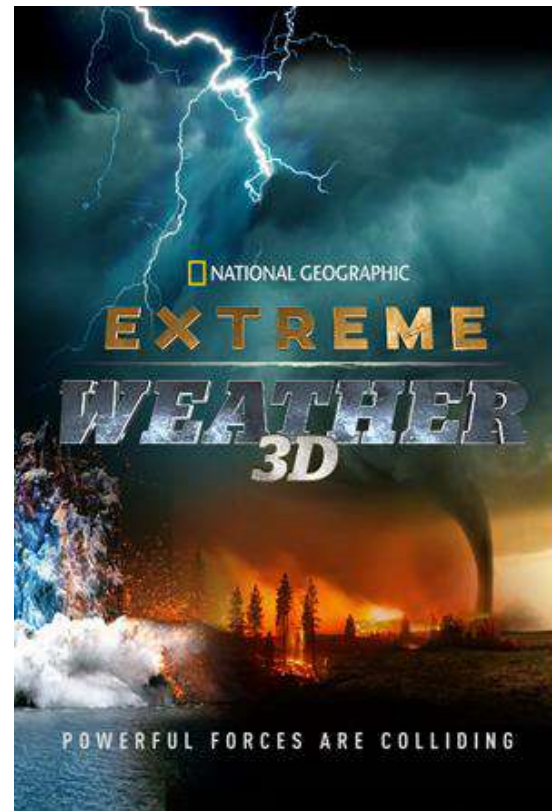
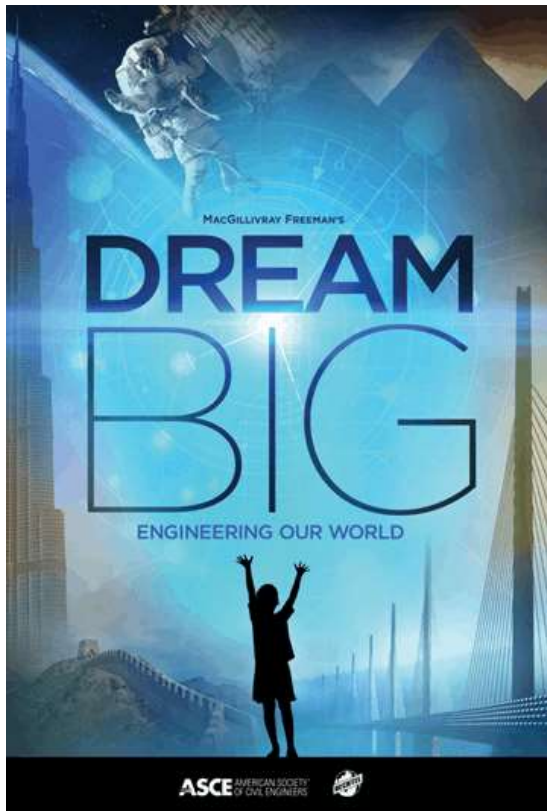
Wild Weather investigates some of nature's more powerful and destructive forces as you put yourself directly in the path of a tornado, inside the eye of a hurricane and in the midst of a raging winter storm. Get drawn into the science behind tornadoes, hurricanes, heat waves, thunderstorms and winter storms through interactives, multimedia experiences, models and large-scale graphics.

[Learn more](#)



Fernbank Museum of Natural History
(All programs require reservations, including free programs)

Now showing in the Fernbank IMAX movie theater:



[DREAM BIG](#)

Showing March 4 – June 16, 2017

Take a journey of discovery from the world's tallest building to a bridge higher than the clouds. *Dream Big: Engineering Our World* is a first film of its kind giant screen theatres that will transform how you think about engineering.

[Extreme Weather 3D](#)

Showing February 4 – May 19, 2017

Weather is one of the most dynamic forces shaping our planet, but now it's more extreme and complex than ever. *Extreme Weather* takes us to the frontlines where few have gone. Travel to the edge of 300-foot-tall glaciers collapsing, to the front lines of massive wildfires, directly in the path of deadly, yet mesmerizing tornadoes. Follow researchers and everyday heroes as they uncover surprising connections to help us understand and adapt to our ever-changing weather.

AGS Officers

President: Ben Bentkowski

bbentkow@gmail.com

Phone (770) 296-2529

Vice-President: Steven Stokowski

sstokowski@tecservices.com

Secretary: Rob White

Phone (770) 891-0519

robeth@bellsouth.net

Treasurer: John Salvino, P.G.

Phone: 678-237-7329

johnsalvino@bellsouth.net

Past President Shannon Star George

AGS 2017 Meeting Dates

Listed below are the planned meeting dates for 2017. Please mark your calendar and make plans to attend.

2017 Meeting Schedule

March 28 Burton Dixon, : PCE

Contaminated Dry Cleaner Site in Georgia

April 25 Randy Bolton, Mineral

Characterization in Environmental Science

May 30

June 27

July 25

PG Study Group meetings

Contact Ken Simonton for the details.

March 25 Cancelled due to Tellus

Symposium

April 29

May 27

June 24

July 29

AGS Committees

AGS Publications: Open

Career Networking/Advertising: Todd Roach

Phone (770) 242-9040, Fax (770) 242-8388

tdr@piedmontdrilling.com

Continuing Education: Open

Fernbank Liaison: Kaden Borseth

Phone (404) 929-6342

Kaden.Borseth@FernbankMuseum.org

Field Trips: Open

Georgia PG Registration: Ken Simonton

Phone: 404-825-3439

kws876@gmail.com

Ginny Mauldin-Kenney

ginny.mauldin@gmail.com

Teacher Grants: Bill Waggener

Phone (404) 354-8752

waggener80@yahoo.com

Hospitality: John Salvino, P.G.

johnsalvino@bellsouth.net

Membership: Burton Dixon

Dixonburton1@gmail.com

Social Media Coordinator: Carina O'Bara

carina_do@yahoo.com

Newsletter Editor: James Ferreira

Phone (508) 878-0980

ferreira.02767@gmail.com

Web Master: Ken Simonton

kws876@gmail.com

www.atlantageologicalsociety.org

ATLANTA GEOLOGICAL SOCIETY

www.atlantageologicalsociety.org

ANNUAL MEMBERSHIP FORM

Please print the required details and check the appropriate membership box.

DATE: _____

NAME: _____

ORGANIZATION: _____

TELEPHONE (1): _____ TELEPHONE (2): _____

EMAIL (1): _____ EMAIL (2): _____



STUDENT \$10 ☐

PROFESSIONAL MEMBERSHIP \$25 ☐

CORPORATE MEMBERSHIP \$100 ☐

(Includes 4 professional members, please list names and emails below)

NAME: _____ EMAIL: _____

NAME: _____ EMAIL: _____

NAME: _____ EMAIL: _____

NAME: _____ EMAIL: _____

For further details, contact the AGS Treasurer:

John Salvino johnsalvino@bellsouth.net

Please make checks payable to the "Atlanta Geological Society" and bring them to the next meeting or remit with the completed form to:

Atlanta Geological Society, Attn: John Salvino
3073 Lexington Avenue
Woodstock, Georgia 30189

Please try our new on-line method of renewing your membership:

<https://squareup.com/store/atlanta-geological-society>

CASH ☐ CHECK (CHECK NUMBER: _____)