3.7 billion-year-old fossils found in Greenland

BY JOEL ACHENBACH
THE WASHINGTON POST

Scientists probing a newly exposed, formerly snow-covered outcropping in Greenland claim they have discovered the oldest fossils ever seen, the remnants of microbial mats that lived 3.7 billion years ago.

It's a stunning announcement in a scientific field that is always contentious. But if confirmed, this would push the established fossil record more than 200 million years deeper into the Earth's early history, and provide support for the view that life appeared very soon after the Earth formed and may be commonplace throughout the universe.

A team of Australian geologists announced their discovery in a paper titled "Rapid emergence of life shown by discovery of 3,700-million-year-old microbial structures," published Wednesday in Nature.

They made their find in July 2012 while doing field research in Isua, a region of Greenland so remote that they had to travel there by helicopter. The site is known for having the oldest rocks on Earth, in what is known as the Isua supracrustal belt. Allen Nutman, a University of Wollongong geologist who has studied the rocks there since 1980, said one day he and his colleagues were working at the site when they spied some outcroppings they'd never seen before. The formations had been exposed where the snowpack had melted — the result, Nutman said, of the global warming that is so pronounced in Greenland or of low levels of snowfall the previous winter.

They examined the outcropping and immediately saw something intriguing: conical structures, just one to four centimeters (less than two inches) high. They look like fossilized microbial mats — basically, pillows of slime — known as stromatolites, which are formed today by bacterial communities living in shallow water.

"We all said, 'This is amazing. These look like stromatolites,'" Nutman told The Washington Post.

Subsequent laboratory analysis established that the formation is 3.7 billion years old, and turned up additional chemical signatures consistent with a biological origin for the conical structures, Nutman said.

Fossilized stromatolites nearly 3.5 billion years old have previously been found in Western Australia. Those fossils have until now been the oldest widely accepted evidence for life on Earth. Some researchers have cited signatures of life from an even earlier time, including in the Isua formation in Greenland, but typically these assertions have involved biologically friendly molecules rather than actual fossils. Moreover, very old rocks — older than 3 billion years — are exceedingly rare, because the Earth's surface has been eroded over time and recycled through plate tectonics.

Claims about evidence for ancient life have invariably been controversial. The multiple lines of evidence for the Greenland stromatolites "are not as clear cut as you'd ideally want for such an extraordinary claim," cautioned Abigail Allwood, a geologist at the NASA Jet Propulsion Laboratory who has studied fossil stromatolites.

"They might really be biological but it's hard to absolutely refute the possibility that they formed by localized mineral precipitation from seawater. If we found these on Mars, would we plant a flag and declare that we had found life on Mars? I think not, but we would definitely get very excited and continue looking around for more information," she said.

"We expect there will be some robust debate. That's what science is all about. There will be people surely who will put forward alternative hypotheses. But we think we've covered all those alternatives," Nutman said.

YURI AMELIN | AUSTRALIAN NATIONAL UNIVERSITY

Allen Nutman (left) of the University of Woollongong and Vickie Bennet of the Australian National University hold a specimen of 3.7 billion-year-old fossils found in Greenland in 2012.

The Australians' claim of Greenland stromatolites is "plausible and likely correct," said J. William Schopf, a pioneering paleobiologist at the University of California at Los Angeles who was not involved in the discovery.

Schopf, who in 1993 reported the discovery of 3.465-billion-year-old microfossils in Western Australia, said he expects scientists to find more Greenland stromatolites as the warming atmosphere continues to melt the huge ice sheet covering the world's largest island.

The Australian researchers do not contend that these stromatolites represent the first examples of life on the planet. Rather, these would have to be the descendants of the earlier life forms. Microbes capable of performing photosynthesis and forming communities are relatively sophisticated organisms. They presumably had less-sophisticated ancestors that lived more than 4 billion years ago, the Nature paper states.

"Stromatolites are really complex, so you have to have a lot of evolution from when life started to when stromatolites appeared in the fossil record. So life either had to start earlier, or evolution is more rapid than you might expect," said Sara Walker, an astrobiologist at Arizona State University who was not involved in the new study.

Earth, along with the other planets in our solar system, formed about 4.5 billion years ago from a cloud of dust and gas swirling around the embryonic sun. For hundreds of millions of years, ours was a harsh, molten world, heavily bombarded by debris. At one point, a Mars-sized object slammed into the Earth and blasted into space the material that eventually cohered into the moon.

Schopf said that when he first began working in paleobiology half a century ago, the leaders of the field believed that life began on Earth only about a billion years ago. Discoveries kept pushing the start date for life further into the past.

An early appearance of life on Earth has implications for the abundance of life beyond Earth. Life on a young Earth could imply that life is a routine development in the universe, and could be, as Nobel laureate Christian de Duve put it, a "cosmic imperative."

"The origin of life, at least on a planet like ours, is a lot faster, and you think a lot easier than anyone had imagined. To the extent that that is true, life ought to be abundant in the universe — because there are lots of Earth-like planets out there," Schopf said.

This remains a matter of conjecture and philosophy, because no one has discovered a sign of extraterrestrial life. The early dates for the origin of life on Earth also could suggest that complex, multi-cellular life (including, perhaps, an intelligent and technological species) typically arises on a planet only after a very long period of evolution and diversification.

No one knows how life began on Earth. Charles Darwin hypothesized that life emerged in a "warm little pond," but other researchers imagine that it emerged around a deep-sea hydrothermal vent, or even came to Earth from space, perhaps after sparking into existence on Mars, or even in some other, distant planetary system.

The Greenland discovery comes just a week after the announcement that astronomers have detected evidence of a "habitable" planet orbiting Proxima Centauri, a red dwarf star that is the sun's closest stellar neighbor. But little is known about that planet other than its mass and temperature, which suggest that, if it has an atmosphere, water could remain liquid at the surface.

Closer to home, Mars remains the top target for the search for extraterrestrial life, and the Greenland discovery, if it holds up, suggests that the investigation on Mars should include a hunt for fossilized stromatolites.

"It means that there is a heightened interest in the search for life on Mars," Nutman said Wednesday. "Three thousand seven hundred million years ago, Mars was wet. If life had managed to evolve to produce structures like stromatolites by 3,700 million years ago on Earth, there is an increased probability — certainly not a certainty — that the same type of process might have happened on Mars before it dried out."

Hike

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to the bog that is just about 1.5 miles long, making for an out-and-back hike of about 3 miles.

From the preserve's gravel parking area, a kiosk is located directly across Schoodic Bog Road and includes trail maps and guidelines for the preserve. From there, the route to the bog starts by tracing the rough, gravel Schoodic Bog Road northwest for 0.5 mile. Along the way, the route is marked with blue diamond Frenchman Bay Conservancy signs, which are posted on trees beside the road. A wooden arrow sign near the kiosk that reads "To Schoodic Bog" also helps you start out in the right direction.

(Be careful not to confuse the Schoodic Bog Trail with the Schoodic Connector Trail, which is new as of summer 2006 and also begins at the kiosk. The Schoodic Connector Trail is a narrow footpath that leads through the forest southwest 2.6 miles to Frenchman Bay Conservancy's Long Ledges Preserve.)

Hike 0.5 mile on this rocky, wide trail and you'll come to a spot where beavers have flooded the trail. Here, Frenchman Bay Conservancy has created a detour trail that enters the woods to your left, dips into a small ravine, crosses a brook on a wooden bridge, then climbs back up to the original trail.

Soon after, the Schoodic Bog Trail ends at the Downeast Sunrise Trail, a multi-use way that runs 85 miles from Ellsworth to Ayers Junction in eastern Maine. This trail is open to ATVs, horses, bicyclists, hikers, skiers, snowshoers and snowmobilers.

Turn right and follow the Downeast Sunrise Trail about 0.2 mile to reach Schoodic Bog. (If you cut straight across the Downeast Sunrise Trail, you will find the Schoodic Mountain Trail, which travels through private land up the west side of Schoodic Mountain. If you decide to hike this trail, be sure to stay on trail and respect that this is private property.)

AISLINN SARNACKI | BDN

Water lilies are in full bloom in Schoodic Bog Preserve in Sullivan recently.

The Downeast Sunrise Trail cuts across Schoodic Bog's northern end on an old railroad bed. At the edge of the bog, you'll find a picnic table set in the bushes to the right side of the trail. Then, continuing across the bog, you'll walk past several old telephone poles that appear to be sinking slowly into the bog. And ahead of you is Schoodic Mountain, which rises 1,069 feet above sea level and is a popular mountain to hike in the area.

If you walk through Schoodic Bog on the Downeast Sunrise Trail, then turn around and retrace your steps to the preserve parking lot, your hike will be about 3 miles total.

Dogs are permitted if kept under control at all times. Beware that ATVs, horses and snowmobiles use the Downeast Sunrise Trail, and it's trail etiquette to keep your dog out of the way of all other visitors.

For information, visit frenchmanbay.org or call 422-2328.

Personal note: We woke up early Saturday, picked up iced coffee in Ellsworth and drove east to Sullivan, a small town incorporated in 1789, rumored to be home to America's oldest documented ghost story. The town also happens to be home to some spectacular hikes.

On that sunny, late summer day, my husband, Derek, and I were headed to Schoodic Bog Preserve, an outdoor destination that had been recommended to me by several people over the years.

The day warmed quickly as we walked along Schoodic Bog Road, following the blue Frenchman Bay Conservancy signs I've come to know so well by visiting many of the land trust's preserves over the years. Along the way, I almost stepped on a snake, which quickly slithered into the underbrush before I could photograph it or even positively identify it. Dark in color with stripes, the snake could have been a ribbon snake or a very distinctly marked garter snake, which is more common.

Also on the rough gravel road, we came across bear feces, which looked like a pile of mashed-up blueberries. In fact, many of the blueberries were still whole. I did some research later on, and I learned that this isn't unusual. Bears tend to swallow blueberries whole, and if the berries aren't soft and ripe enough, they won't be broken up in the bear's stomach, according to the North American Bear Center. ("Bear poop" is not the oddest thing I've researched on Google at work, trust me.)

As we walked through Schoodic Bog on the Downeast Sunrise Trail, I photographed white water lilies in full bloom, a cedar waxwing perched atop a tall pine and a baby eastern painted turtle basking in the sun, so small that it could rest above water on a lilypad. A fresh breeze combed through the tall grasses of the bog, and every once in awhile, a couple ATVers or bicyclists passed by on the trail.

We were nearly at the other side of the bog when we turned back and traced our steps back to the parking lot. Along the way, we spotted a smooth green snake, also known as a grass snake, and a young hermit thrush, which soon will fly south to spend the winter in a warmer place.

For more of Aislinn Sarnacki's adventures, visit her blog at actoutwithaislinn.bangordailynews.com. Follow her on Twitter: @1minhikegirl.

Things to Do
Outdoors

BANGOR — Bangor Land Trust's Pedal the Penobscot celebrates cycling and supports Bangor's wild backyard, offering five distance options, 6:30 a.m.-3 p.m. Sunday, Sept. 11, from Bangor Waterfront and High Tide Restaurant in Brewer. Riders of all ages and abilities welcome. Ride solo, with a friend or register a team. Riders receive an annual membership to Bangor Land Trust and are entered into a raffle for prizes donated by area businesses. The first 150 to register also receive a 10th anniversary shirt.

BAR HARBOR — Second annual Northeast Climate Bicycle Ride from Bar Harbor to Boston, fundraiser and "green conference on wheels" with more than 200 bicyclists traveling 390 miles along the coastline, Sept. 8-12. Designed to raise awareness of sustainability, renewable energy, climate change issues and bicycle advocacy. Each rider will raise at least $2,800 to benefit one of more than 100 organizations including Rails-to-Trails Conservancy, Sierra Club, 350.org, B Lab, Rainforest Alliance, Food & Water Watch, Maine Farmland Trust and others. Participants will cycle approximately 60 miles a day and hear from guest speakers who are leaders in sustainability and green innovation on topics including climate science, sustainable living, bicycle advocacy, and environmental activism. climateride.org/events/northeast.

BAR HARBOR — Carey Kish, veteran hiker, photographer, registered Maine Guide, author and founding member of Maine Outdoor Adventure Club who has thru-hiked the Appalachian Trail twice, will talk about his 2015 trip, 7 p.m. Friday, Sept. 2, Jesup Memorial Library, 34 Mount Desert St. Part of Cadillac Mountain Sports Speaker Series. 288-4245 or kchagnon@jesuplibrary.org.

DEDHAM — Teach a kid to fish events, noon-2 p.m., 2-4 p.m. and 4-6 p.m. Saturday through Monday, Sept. 3-5, Peaked Mountain Farm, 6 Ellerys Lane. Children must be accompanied by adult, wear a life vest and have a fishing rod. $6 per child. One fish per child. Registration required at peakedmountainfarm.biz. 249-5002 or email peakedmtfarm@aol.com.

GREENVILLE — Moosehead Trails seeks volunteers for a trail work day, 9 a.m.-4:30 p.m. Friday, Sept. 9, Big Moose Mountain. Fourth and final stewardship trip of the season. Open to all. Meet at intersection of North Road and Route 15. Bring lunch, water, work gloves and bug repellant. Some tools provided but volunteers encouraged to bring loppers, pruners and hand saws. Rain date Saturday, Sept. 10. Erica Kaufmann, erica@fsmaine.org.

ORLAND — Hike Mead Mountain Trail, which turns into the new Mead Mountain path to the overlook, 10 a.m. Saturday, Sept. 10, meeting at South Gate on Route 1 near Route 176 intersection to carpool. Bring water. Check Facebook page or greatpondtrust.org for weather-related cancellations. 469-6929 or info@greatpondtrust.org.

WINSLOW — Bowhunting safety course with Don Perrine, 8 a.m.-6 p.m. Sunday, Sept. 11, Winslow Fire Department. 238-0279.

WINTER HARBOR — Maine public health representatives will provide information on lowering risk of exposure to tick- and mosquito-borne illness, rabies virus and marine toxins, 3:30-5 p.m. Monday, Sept. 12, Moore Auditorium, Schoodic Institute, Acadia National Park. Free and open to all. schoodicinstitute.org/events.

For a complete listing of calendar items or to submit your event, visit www.bangordailynews.com.