Ancient Sea Animals Provide Missing Link

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PALEONTOLOGY—The fossils of tiny marine animals found in Canada this year may hold the key to how life evolved from microbes to humans.

In July Guy Narbonne of Queen's University in Ontario reported a new population of fossils, called rangeomorphs. The extinct animals are, he says, the most ancient complex organisms ever found on Earth. They look more like plants than animals, with branches, stems and leaflike structures. "Those things are a failed experiment. They're either right at the base of animal evolution or even a little bit further back behind, maybe on a link between the fungi and the animals," says Narbonne. "And they are unrelated to anything on Earth today."

The fossils were perfectly preserved under a layer of volcanic ash. Just like Pompeii, every organism died where it lived. Most other fossil sites were caused by more turbulent occurrences, like hurricanes, and are often a jumbled mess. This difference allows Narbonne to use ecology to further understand the animals. "When you walk on a rock surface, it's like walking on a 565 million-year-old seafloor," he says. "Because of that, we can apply modern techniques in spatial ecology that have never been applied to the fossil record before. If you study the ecosystem, you can see how they fed, how they lived and that puts constraints on what they were." —*Anne Sasso*

This perfectly perserved frondlet from the Ediacaran Period 575 million years ago was an early experiment in animal life that never evolved into another stage.

Meteors Delivered Fifth Element

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GEOLOGY—Scientists argue that life's building blocks—carbon, oxygen, hydrogen, and nitrogen—were abundant in early Earth. But where did the fifth critical element—phosphorus—come from?

In August researchers at the University of Arizona found an answer: schreibersite, an iron-nickel phosphide that occurs in iron meteorites, could have provided all the phosphorus needed. "We're suggesting that...meteorites played a role in the origin of life," says Matthew Pasek, a doctoral student at the university's Lunar and Planetary Laboratory.

Dante Lauretta, an assistant professor and Pasek's thesis supervisor, sees a two-parent meteorite scenario. "You've got the carbonaceous meteorites bringing in your amino acids, sugars, and nucleobases," he says. But they lack phosphorus. "Iron meteorites would bring that in very nicely," he theorizes. "The reason that life originated on Earth is because this is the place where you have liquid water. Where all these components could then meet and mix and react with each other."

Researchers found the link by submerging phosphorus-bearing meteorites in pure water. "All the phosphates were pretty boring, but then we hit this phosphide—schreibersite—and it was the most beautiful NMR [nuclear magnetic resonance] spectrum that Matt had ever produced," Lauretta says. "It meant that there were a lot of different and complicated compounds in there. And then we said, 'This is important!'" —*Anne Sasso*

Inner Earth Revealed

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GEOLOGY—The center of the Earth is 3,958.7 miles beneath our feet. But, so far, geologists know for sure only what lies in the top 100 miles or so. Everything below that can only be surmised from seismic waves of earthquakes as they travel through the inner earth. This year, geologists uncovered another clue. A newly discovered mineral phase, called post-perovskite, may solve a long-standing enigma: the composition of the D double prime layer, or D".

First defined in 1950, the D" layer is an enigmatic layer 1,700 miles beneath the surface, one that forms the boundary between the silicate-rock mantle and the molten iron core. There, seismic waves dramatically change speed and direction. "Many kinds of large seismic anomalies are observed, but their cause has been unclear," says Kei Hirose, a mineralologist at the Tokyo Institute of Technology.

Since Hirose and his colleagues could not drill into the D" layer, they experimented in the lab. Geologists have long suspected that the lower mantle is composed largely of perovskite, a magnesium silicate mineral. Hirose squeezed perovskite between two gem-quality diamonds, called anvils, and heated it with a powerful laser beam to duplicate the high temperatures and pressures thought to exist in the 125- to 185-mile thick D" layer. The density and compressibility of the squashed rock was then measured with X-rays.

What they found was totally new: an unknown crystal structure with similar chemical composition to perovskite. They called it post-perovskite. The mineral has a unique layered structure that causes seismic waves to change velocity depending on their direction of travel—just as in the D" layer. "This phase can explain many of the seismic anomalies that have never been well explained," says Hirose. "We finally opened the door at the bottom of the mantle and discovered the secret there." —*Anne Sasso*

Geologists Name First New Period In 103 Years

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GEOLOGY—For the first time since 1891, the geologic timescale is getting a new period. In March the International Union of Geological Scientists added the Ediacaran to the Precambrian Eon, an enormous time frame that covers 90 percent of geologic history.

The new period takes its name from Ediacaran fossils, remains of the oldest-known complex animal life, that were found in abundance in the Ediacaran Hills of South Australia. The period begins around 620 million years ago with the rapid end of the global Marinoan glaciation—a great environmental calamity that entombed the planet in ice for several million years. It ends 543 million years ago with the onset of the Cambrian Period and the explosion of animal life.

As geologists readily admit, the table has its shortcomings. While the most recent 543 million years—the Phanerozoic Eon—are heavily subdivided into three eras and 11 periods, the remaining 4.1 billion years are lumped into a single eon, the Precambrian, and have few defining divisions. "This shows that we are now coming to understand at least the younger-most part of this hugely long interval of time in enough detail to treat it the way we treat younger rocks," says Andrew Knoll, professor of biology at Harvard University. "It truly reflects our improving scientific understanding of the past."

Although none of the other periods are named for fossils, they are key when it comes to geological timing. Phanerozoic rocks are full of fossils; older rocks are not. A great achievement of 19th-century science, Knoll says, was learning to use fossils as distinctive time indicators. "That allowed this wonderful scale to come into being," he says. The goal now, he adds, is to "carry this work back through the Precambrian, to try to bring eventually all of the Precambrian up to the same standard for a geologic timescale that we have for the Phanerozoic. The next step for the Ediacaran Period is further subdivision. "People are constantly working to make a scale that is more reliable, more highly resolved," Knoll says. "There's a pretty good cottage industry in doing that." —*Anne Sasso*