Large bacterial population colonized land 2.75 billion years ago

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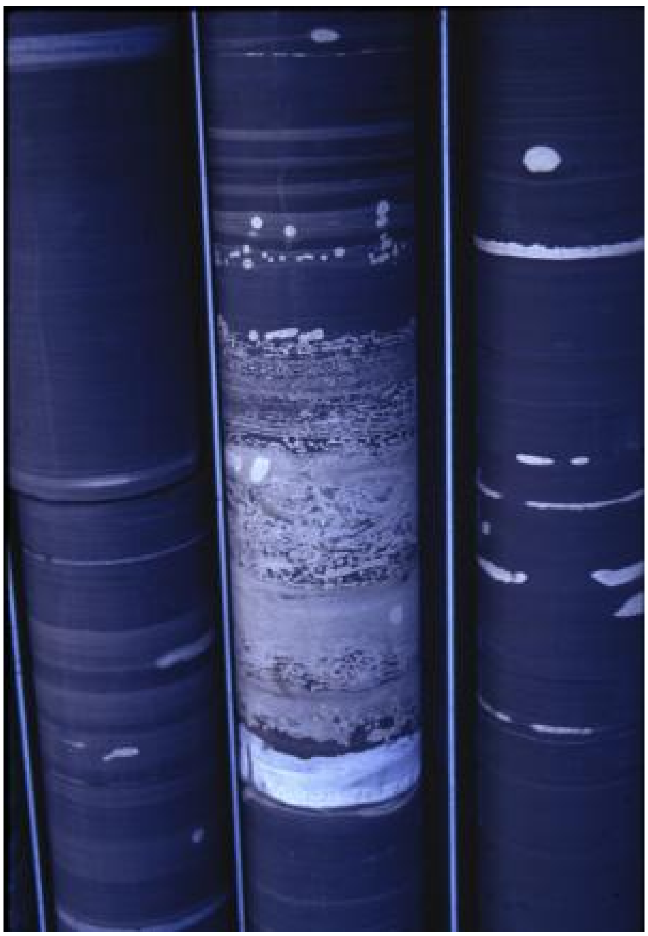

A drill core from the 2.5 billion-year-old Mount McRae Shale formation in Western Australia, which originally was fine-grained ocean sediment, shows high concentrations of sulfide and molybdenum. That supports the idea that most of the sulfate came from land, likely freed by microbial activity on rocks. Some data for the research came from the Mount McRae formation. Credit: Roger Buick/UW

(Phys.org)—There is evidence that some microbial life had migrated from the Earth's oceans to land by 2.75 billion years ago, though many scientists believe such land-based life was limited because the ozone layer that shields against ultraviolet radiation did not form until hundreds of millions years later.

But new research from the University of Washington suggests that early microbes might have been widespread on land, producing oxygen and weathering pyrite, an iron sulfide mineral, which released sulfur and molybdenum into the oceans.

"This shows that life didn't just exist in a few little places on land. It was important on a global scale because it was enhancing the flow of sulfate from land into the ocean," said Eva Stüeken, a UW doctoral student in Earth and space sciences.

In turn, the influx of sulfur probably enhanced the spread of life in the oceans, said Stüeken, who is the lead author of a paper presenting the research published Sunday (Sept. 23) in *Nature Geoscience*. The work also will be part of her doctoral dissertation.

Sulfur could have been released into sea water by other processes, including volcanic activity. But evidence that molybdenum was being released at the same time suggests that both substances were being liberated as bacteria slowly disintegrated continental rocks, she said.

If that is the case, it likely means the land-based microbes were producing oxygen well in advance of what geologists refer to as the "Great Oxidation Event" about 2.4 billion years ago that initiated the oxygen-rich atmosphere that fostered life as we know it.

In fact, the added sulfur might have allowed marine microbes to consume methane, which could have set the stage for atmospheric oxygenation. Before that occurred, it is likely large amounts of oxygen were destroyed by reacting with methane that rose from the ocean into the air.

"It supports the theory that oxygen was being produced for several hundred million years before the Great Oxidation Event. It just took time for it to reach higher concentrations in the atmosphere," Stüeken said.

The research examined data on sulfur levels in 1,194 samples from marine sediment formations dating from before the Cambrian period began about 542 million years ago. The processes by which sulfur can be added or removed are understood well enough to detect biological contributions, the researchers said.

The data came from numerous research projects during the last several decades, but in most cases those observations were just a small part of much larger studies. In an effort to provide consistent interpretation, Stüeken combed the research record for data that came from similar types of sedimentary rock and similar environments.

"The data has been out there for a long time, but people have ignored it because it is hard to interpret when it is not part of a large database," she said.

Provided by University of Washington

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