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Scientists Find Microfossils Challenge Prevailing Views of the Effects of 'Snowball Earth' Glaciations on Life

New fossil findings discovered by scientists at UC Santa Barbara challenge prevailing views about the effects of "Snowball Earth" glaciations on life, according to an article in the June issue of the journal Nature Geoscience.

By analyzing microfossils in rocks from the bottom of the Grand Canyon, the authors have challenged the view that has been generally assumed to be correct for the widespread die-off of early life on Earth.

"Snowball Earth" is the popular term for glaciations that occurred between approximately 726 and 635 million years ago and are hypothesized to have entombed the planet in ice, explained co-author Susannah Porter, assistant professor of earth science at UCSB. It has long been noted that these glaciations are associated with a big drop in the fossil diversity, suggesting a mass die-off at this time, perhaps due to the severity of the glaciations. However, the authors of the study found evidence suggesting that this drop in diversity occurred some 16 million or more years before the glaciations. And, they offer an alternative reason for the drop.

A location called the Chuar Group in the Grand Canyon serves as "one of the premier archives of mid-Neoproterozoic time," according to the article. This time period,

before Snowball Earth, is preserved as a sort of "snapshot" in the canyon walls.

The scientists found that diverse assemblages of microscopic organic-walled fossils called acritarchs, which dominate the fossil record of this time, are present in lower rocks of the Chuar Group, but are absent from higher strata. In their place, there is evidence for the bacterial blooms that, the authors hypothesize, most likely appeared because of an increase in nutrients in the surface waters. This process is known as eutrophication, and occurs today in coastal areas and lakes that receive abundant runoff from fertilizers used in farming.

"One or a few species of phytoplankton monopolizes nutrients at the expense of others," said Porter, explaining the die-off of diverse acritarchs. "In addition, the algal blooms result in high levels of organic matter production, which we see evidence of in the high organic carbon content in upper Chuar Group rocks. In fact, the organic carbon content is so high in the upper Chuar Group, oil companies were interested in the Chuar Group as a possible source of oil and natural gas." As a result of high levels of organic matter, oxygen levels in the water can become depleted, resulting in widespread "dead zones." Porter and colleagues also found evidence for extreme anoxia in association with the bacterial blooms.

In an accompanying article describing the process of discovering the microfossils, Porter described a highlight of the trip, "...when we rode through the rapids and descended into 'Powell's bowels' -- where the oldest rocks in the Grand Canyon frame the river passage. These rocks formed deep in the Earth approximately 1.8 billion years ago, and are very different in appearance from the overlying rocks."

The scientists braved extreme sun, rattlesnakes, scorpions, and dehydration to gather their data. They traveled by foot, helicopter, and river rafts, the last of which capsized on one occasion -- although the samples remained intact.

The first author on the paper is former UCSB graduate student Robin Nagy, who did the research as part of her work to obtain her master's degree. Nagy now teaches seventh and eighth grade science at Williams Elementary Middle School in Williams, Arizona. Other co-authors are Carol M. Dehler of Utah State University, and Yanan Shen of the University of Quebec.

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