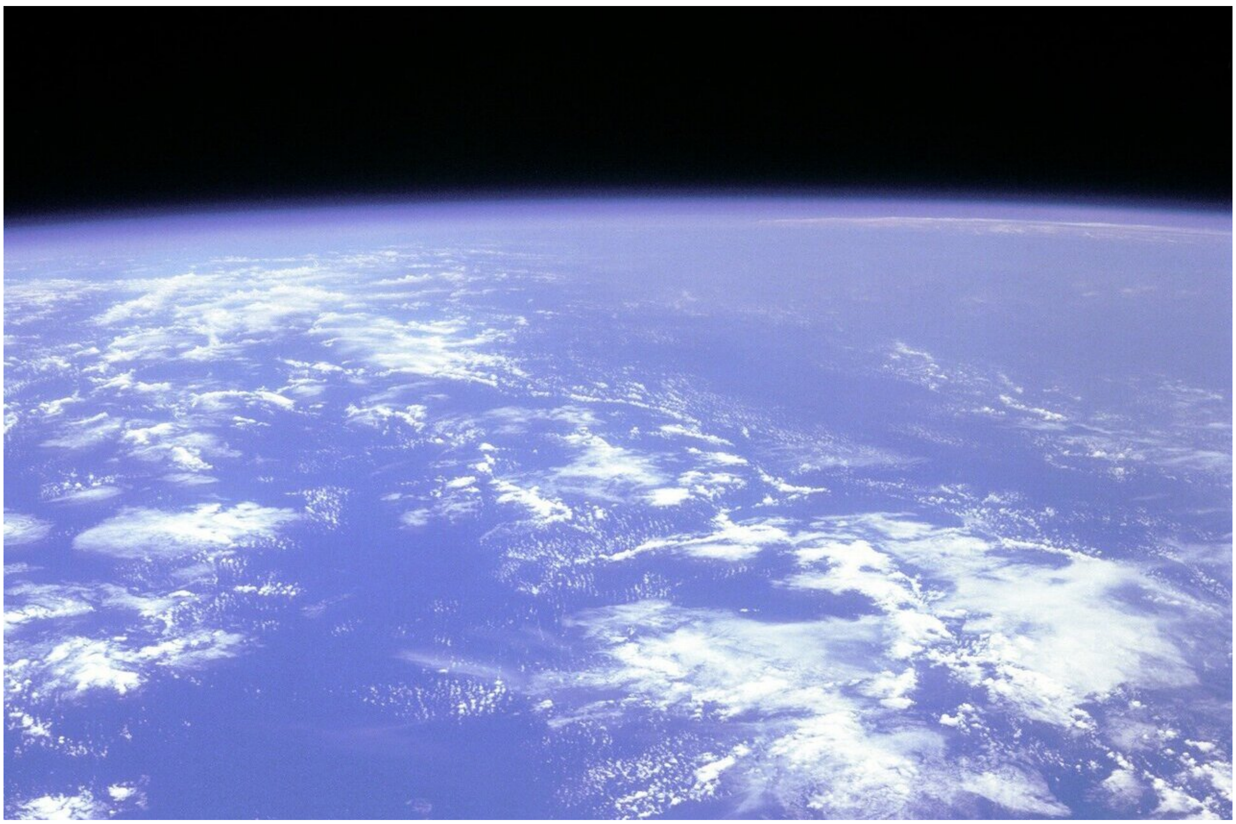
'Seafloor fertilizer factory' helped breathe life into Earth

March 10 2022



Credit: Pixabay/CC0 Public Domain

Scientists reveal a new part of the recipe for complex life on planets, and it involves the onset of a microbial fertilizer factory on the Earth's seafloor roughly 2.6 billion years ago.

The first major rise in oxygen levels on the Earth took place roughly 2.4 to 2.2 billion years ago during the early stage of the Great Oxidation Event.

Scientists are still unsure why and how the Great Oxidation Event occurred. Some believe it was initiated by rising levels of phosphorus in the ocean, which drove photosynthesis and enhanced oxygen production, while other researchers think it might be related to a declining release of reactive gasses from volcanoes, which consumed less of the oxygen being produced.

Now a team of international scientists, led by the University of Leeds, have used a new technique to measure phosphorus cycling between the ocean and seafloor in 2.6 billion year old rocks from South Africa, leading up to the Great Oxidation Event.

The laboratory measurements from these rocks show that this process of recycling phosphorus back into the seawater fueled photosynthetic bacteria, which increased oxygen levels.

Their study, published today in *Nature Geoscience*, concluded that the establishment of this "seafloor fertilizer factory" was a precondition for the rise of oxygen levels on Earth, and could be an important factor in the potential for other planets to support complex life.

Lewis Alcott, who is now based at Yale University in the US, led the research while a Ph.D. student in the School of Earth and Environment at Leeds. He said: "It may be this process is key to a planet becoming oxygenated and therefore ultimately able to host complex life."

"Untangling the recipe that leads to an oxygen-rich environment can help us assess the possibility of similar occurrences on other planets."

Study senior author, Professor Simon Poulton from the School of Earth and Environment at Leeds, says that "a key part of this recipe is the availability of sulfate, as it is an important component of the recycling process. So, an abundance of sulfur could also be an important requirement for an oxygenated world."

The rise of atmospheric oxygen during the Great Oxidation Event some 2.4 billion years ago was a defining transition in the evolution of global biogeochemical cycles and life on Earth.

However, a growing body of research has shown that oxygen began to be produced by cyanobacteria several hundred million years before the Great Oxidation Event.

Study co-author Dr. Andrey Bekker, of the University of California, Riverside said: "This initial oxygen production led to an increase in seawater sulfate, and this kick-started the recycling process, allowing oxygen production rates to increase enough to oxygenate the atmosphere."

Lead Ph.D. supervisor and study co-author, Dr. Benjamin Mills from the School of Earth and Environment, says that "this study not only furthers our understanding of the history of our planet, but also helps us understand its current processes."

"There is a concern that this same phosphorus recycling process has contributed to dangerous ocean anoxic events—because even though it oxygenates the atmosphere, it actually removes oxygen from the ocean when the photosynthetic microbes decay.

"It is beginning to do so now as part of climate change. Due to a combination of rising temperatures and increased use of phosphorus as an agricultural fertilizer, ocean oxygen levels are decreasing."

More information: Lewis Alcott, Earth's Great Oxidation Event facilitated by the rise of sedimentary phosphorus recycling, *Nature Geoscience* (2022). DOI: 10.1038/s41561-022-00906-5

Provided by University of Leeds