Ocean changes almost starved life of oxygen

March 2 2020

Credit: CC0 Public Domain

Chemical changes in the oceans more than 800 million years ago almost destroyed the oxygen-rich atmosphere that paved the way for complex life on Earth, new research suggests.

Then, as now, the planet had an "oxidizing" atmosphere, driven by

phytoplankton—the "plants" of the ocean—releasing oxygen during photosynthesis.

However, new research from an international team including the University of Exeter and spanning Toulouse, Leeds, London and Nanjing, suggests ocean changes in the early Neoproterozoic era (from one billion to 800 million years ago) may have locked away phosphorus—a vital nutrient for life—limiting phytoplankton growth and oxygen release.

The study suggests the amount of phosphorus available remained "just sufficient" to support the oxidising atmosphere—preventing a return to the "reducing" (oxygen-poor) atmosphere that existed over a billion years earlier.

"Ocean chemistry in this period changed to become 'ferruginous' (rich in iron)," said Dr. Romain Guilbaud, of CNRS (Toulouse).

"We know ocean chemistry affects the cycle of phosphorus, but the impact on phosphorus availability at this time hadn't been investigated until now.

"By analysing ocean sediments, we found that iron minerals were very effective at removing phosphorus from the water."

Phytoplankton growth also boosts atmospheric oxygen because, having split carbon and oxygen and released the oxygen, plants die and their carbon is buried—so it cannot recombine with oxygen to form carbon dioxide.

Despite reductions in photosynthesis and this organic burial of carbon, both due to limited phosphorus, the study suggests oxygen in the atmosphere dropped no lower than 1% of current levels—"just enough"

to maintain an oxidizing atmosphere.

"Our observations suggest significant potential variability in atmospheric oxygen concentrations across Earth's 'middle age'," said Professor Tim Lenton, Director of the Global Systems Institute at the University of Exeter.

He added: "One question about the emergence of complex life is why it didn't happen sooner.

"Lack of oxygen and lack of nutrients are two possible reasons, and our study suggests both of these may have been the case in the early Neoproterozoic era.

"In fact, if phosphorus levels in the water had dropped any lower, it could have tipped the world back into a 'reducing' atmosphere suitable for bacteria but not for complex life."

A return to a "reducing" atmosphere would have reversed the Great Oxidation Event, which occurred about 2.5 billion years ago, during which photosynthesis by cyanobacteria in the oceans introduced free oxygen to the atmosphere.

More information: Feifei Zhang et al. Extensive marine anoxia associated with the Late Devonian Hangenberg Crisis. March 2020 *Earth and Planetary Science Letters* 533:115976. DOI: 10.1016/j.epsl.2019.115976

Provided by University of Exeter

from https://phys.org/news/2020-03-ocean-starved-life-oxygen.html