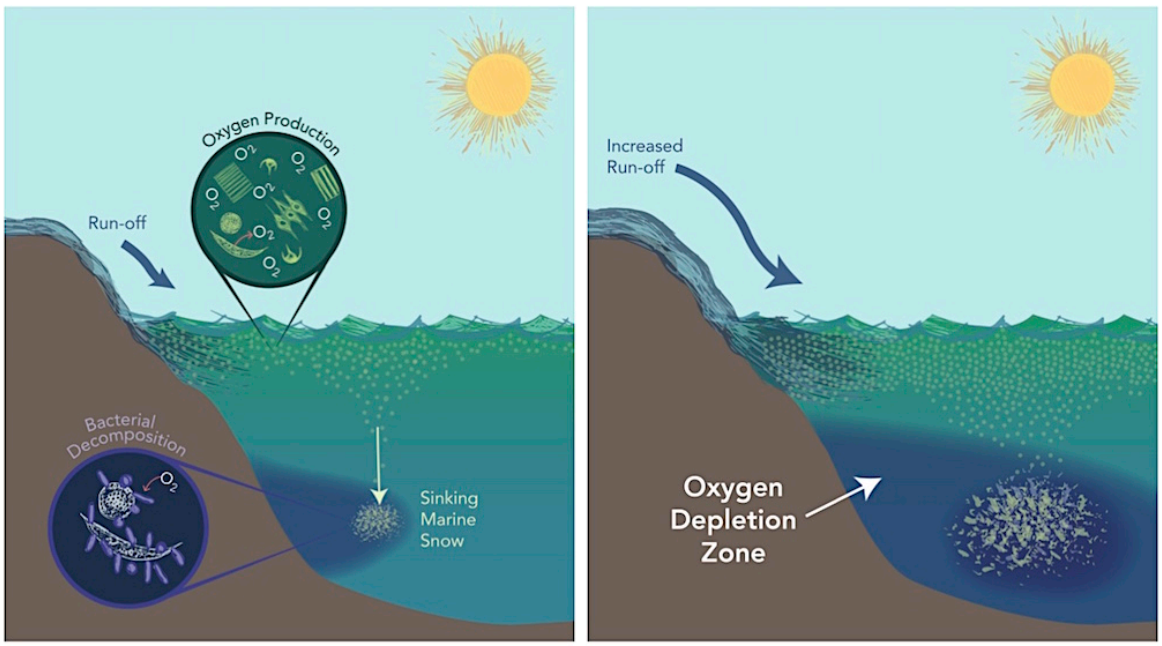
Study estimates oxygen loss in ancient global ocean

August 9 2017



Adding nutrients to the ocean causes increased production of organic matter such as phytoplankton. When these die, they sink to the bottom as "marine snow" and decompose, consuming oxygen in the process. This is thought to be primarily responsible for large-scale oxygen loss in ancient oceans, leading to mass extinctions in the marine environment. The modern ocean exhibits similar symptoms. Credit: Natalie Renier, Woods Hole Oceanographic Institution

A loss of oxygen in global ocean seawater 94 million years ago led to a mass extinction of marine life that lasted for roughly half a million years.

Scientists have found several potential explanations for how the loss of oxygen happened. These could include enhanced volcanic activity, increased nutrients reaching the ocean, rising sea levels, and warming sea and surface temperatures. But to point a finger at any one cause (or several of them) requires knowing how fast the oxygen loss happened.

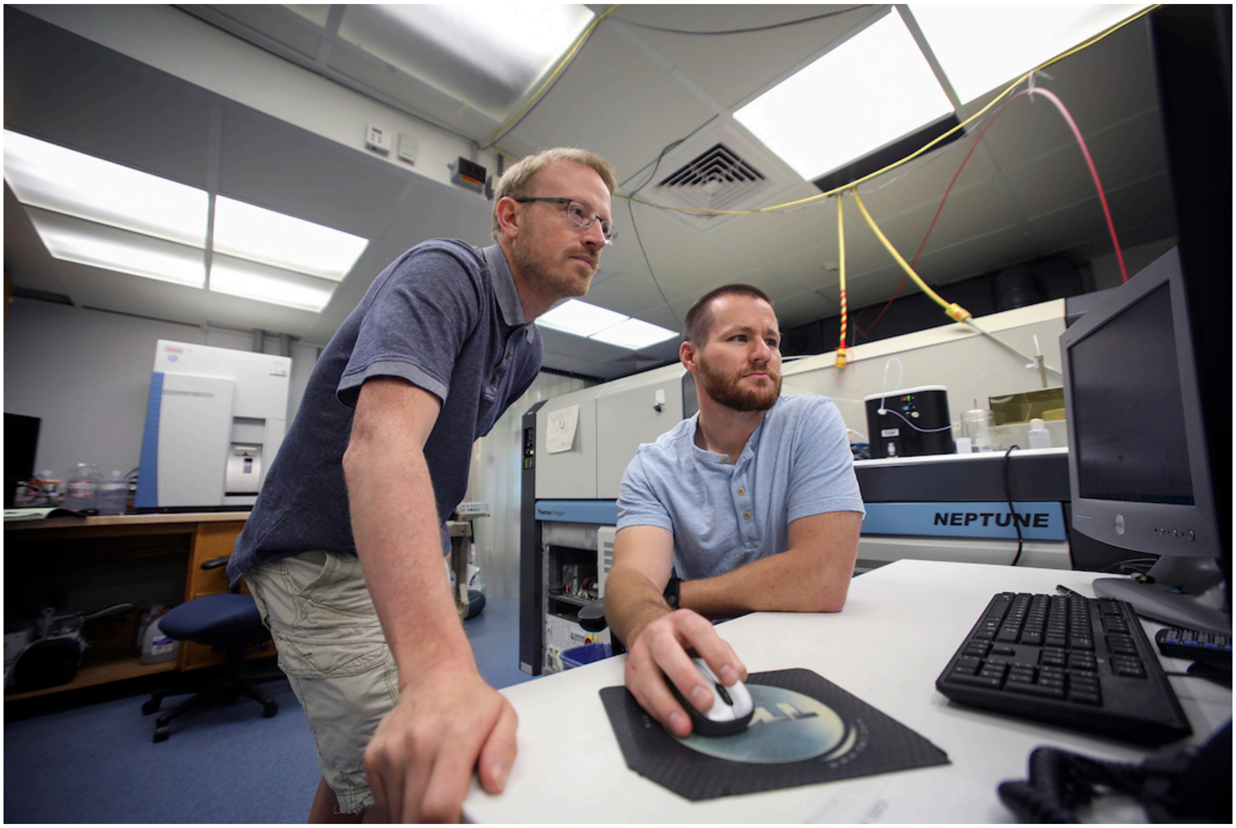
A new technique, developed by Arizona State University graduate student Chad Ostrander with colleagues at Wood Hole Oceanographic Institution (WHOI) and Florida State University (FSU), has put a timetable on the oxygen loss associated with this major ocean extinction event, which is known to science as Oceanic Anoxic Event 2.

Their research was published August 9, 2017, in the journal *Science Advances*.

"The project began when I was an undergraduate Summer School Fellow at Woods Hole," says Ostrander, a PhD student at ASU's School of Earth and Space Exploration. His coauthors on the paper are Jeremy Owens at Florida State and Sune Nielsen at Woods Hole.

"We were able to track changes to the oxygen content of ancient seawater by measuring isotopes of thallium in ancient seafloor sediments," Ostrander explains. "Since the oxygen in the rocks we measure wouldn't really give any valuable information, we use thallium and other elements as stand-ins, or proxies."

Sediments preserve the thallium isotope composition of seawater, which changes depending on the amount of oxygen in the deep ocean at the time they were deposited. The sediments pile up over time, with deeper levels corresponding to times further in the past.



Coauthors Sune Nielsen (left) of Woods Hole Oceanographic Institution and Chad Ostrander from Arizona State University working in the lab. Credit: Matt Barton, WHOI

The sediments the team studied were organic-rich black shales collected as core samples by deep ocean drilling in 2003. The site was the Demerara Rise, a submarine plateau in the Atlantic Ocean off the coasts of Surinam and French Guyana.

"We dissolved the rocks in our lab," explains Ostrander, "and then chemically separated everything but thallium, the element we needed for analysis."

Then using mass spectrometry, the team measured variations in thallium within sedimentary rocks as a proxy for changes in oxygen levels over tens of thousands of years.

Based on the analysis, the researchers suspect that up to half of the deep ocean had become oxygen-depleted during Oceanic Anoxic Event 2, and remained so for about half a million years before it recovered.

"The loss of oxygen took 43,000 years to occur, plus or minus about 11,000," says Ostrander. "Call it 50,000 years or less."

The primary cause of Oceanic Anoxic Event 2 may have been increased nutrient delivery to the oceans, the researchers say. An increase in nutrients fuels the production of organic matter, and subsequent remineralization by bacteria feeding on it.

"It's this remineralization that is specifically responsible for the oxygen loss, because these bacteria consume oxygen in order to oxidize the organic, or carbon-bearing, matter," Ostrander says. "We see a similar scenario in the modern ocean, again due to increased nutrient delivery, but largely driven by fertilizers used in farming."

Oceanic Anoxic Event 2 is easily observed in the Furlo section as a black organic-rich shale inbetween white carbonates. Credit: Jeremy Owens

In fact, he says, "the largest 'dead zone' observed in the Gulf of Mexico is occurring right now for this very reason."

The researchers draw a distinct parallel between the rate of deoxygenation back then and modern trends in oceanic oxygen loss.

Says co-author Nielsen, "Our results show that marine deoxygenation rates prior to the ancient event were likely occurring over tens of thousands of years, and are surprisingly similar to the two percent oxygen depletion trend we're seeing induced by human-related activity over the last 50 years."

He adds, "We don't know if the ocean is headed toward another global anoxic event, but the trend is, of course, worrying."

Ostrander says, "At this point, we are only just beginning to understand how oxygen levels in the ocean have changed in the past. But with our new tool, we've already learned that one of the most extreme climate events in the sedimentary record provides an uncomfortably reasonable analog for possible future ocean oxygen loss and subsequent ecological shifts."

He adds, "We hope to use this information to gain a better look into the short-, medium- and long-term future for oxygen content in today's oceans."

More information: C.M. Ostrander at Arizona State University in Tempe, AZ el al., "Constraining the rate of oceanic deoxygenation leading up to a Cretaceous Oceanic Anoxic Event (OAE-2: ~94 Ma)," *Science Advances* (2017). advances.sciencemag.org/content/3/8/e1701020

Provided by Arizona State University

Citation: Study estimates oxygen loss in ancient global ocean (2017, August 9) retrieved 9 April 2024 from https://phys.org/news/2017-08-oxygen-loss-ancient-global-ocean.html