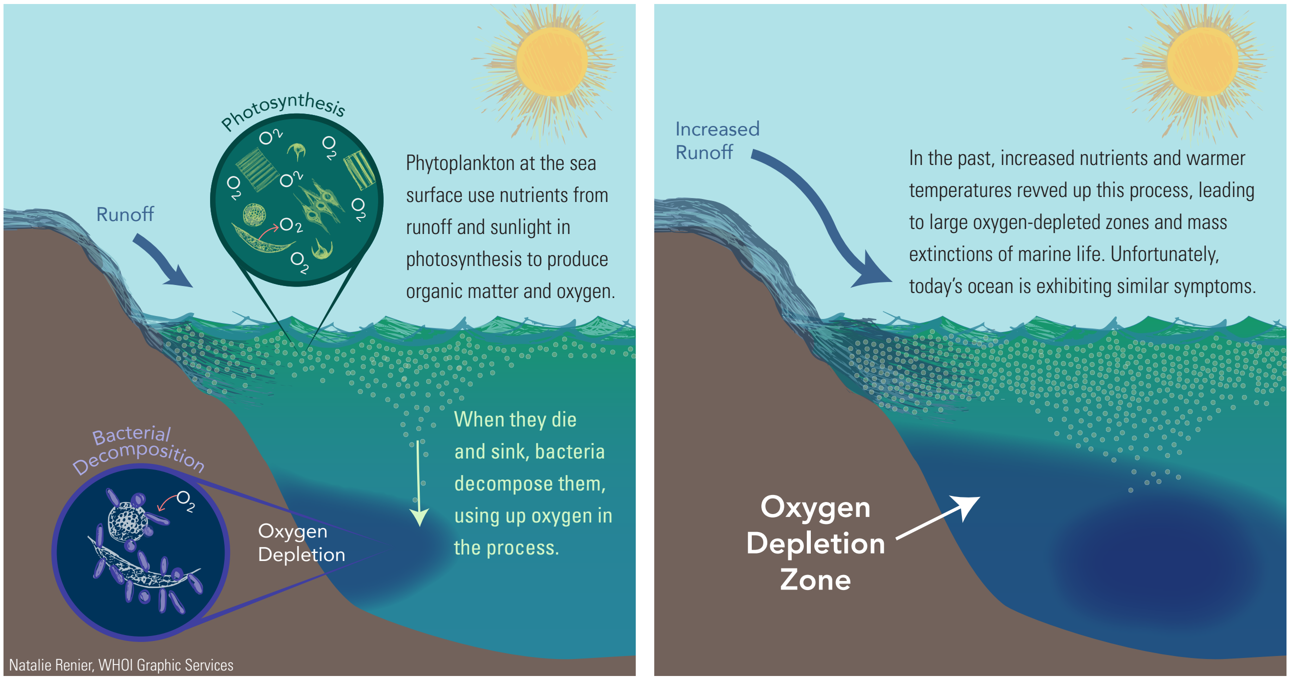
Will Oxygen in the Ocean Continue to Decline?

NEW TECHNIQUE MEASURES HOW FAST DEOXYGENATION CAN HAPPEN

by Evan Lubofsky



Natalie Renier, WHOI Graphic Services

The living, breathing ocean may be slowly starting to suffocate. The ocean has lost more than two percent of its oxygen over the past-half century, and oxygen-depleted "dead zones" continue to expand throughout the global ocean.

This deoxygenation poses a serious threat to marine life and ecosystems. Yet scientists have had no way to measure how fast oxygen depletion happens.

But now a research team at Woods Hole Oceanographic Institution has developed for the first time a way to measure how fast deoxygenation occurred in ancient oceans—a technique that may lay the groundwork for projecting how present-day oxygen losses in the ocean may progress in the future.

The scientists investigated one of the ocean's most extreme periods of deoxygenation, known as Oceanic Anoxic Event 2, or OA2. It led to a catastrophic global extinction of marine animals 94 million years ago, when dinosaurs roamed the Earth.

WHOI geochemist Sune Nielsen teamed with Chadlin Ostrander, an undergraduate in the WHOI Summer Student Fellowship Program, and Jeremy Owens, a WHOI postdoctoral fellow, to analyze 94 million-year-old rocks drilled from below the seafloor off the coast of Suriname, South America. The rocks were made of sediments that had piled up on the seafloor over time, with deeper levels corresponding to periods further in the past.

The sediments preserve heavier and lighter isotopes of thallium that came from ancient seawater. The key to the scientists' technique is that the relative amount of the heavier thallium isotope in the sediments increased when oxygen levels diminished in seawater at the time the sediments were deposited. Using mass spectrometry, the scientists could measure changes in thallium isotopes to reveal changes in oxygen levels occurring over tens of thousands of years, Ostrander said.

Their analysis suggested that up to half of the deep ocean had become oxygen depleted during OA2 and remained anoxic for an estimated half-million years before it recovered. More significantly, they were able to draw a parallel between the rate of deoxygenation then and now.

"Our results show that marine deoxygenation rates prior to the ancient event were surprisingly similar to the two-percent oxygen depletion trend we're seeing induced by anthropogenic activity over the past fifty years," said Nielsen. "We don't know if the ocean is headed toward another global anoxic event, but the trend is, of course, worrying."

"At this point, we are only just beginning to understand how oxygen levels in the ocean have changed in the past," said Ostrander. "But with our new tool, we've already learned that one of the most extreme climate events in the deep-time sedimentary record provides an uncomfortably reasonable analogue for possible future ocean deoxygenation and subsequent ecological shifts. We hope to be able to leverage this information to gain visibility into what the short-, medium-, and long-term future will bring for oxygen content in the ocean."

There are several theories for the cause of OA2, but one cause for modern deoxygenation is clear: More nutrient-rich fertilizers and wastewater from land are running off into the ocean, which stimulates blooms of phytoplankton. When the plankton die and sink, marine microbes consume them, using up oxygen in seawater during the process. More runoff equals more phytoplankton equals more deoxygenation. ▲

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