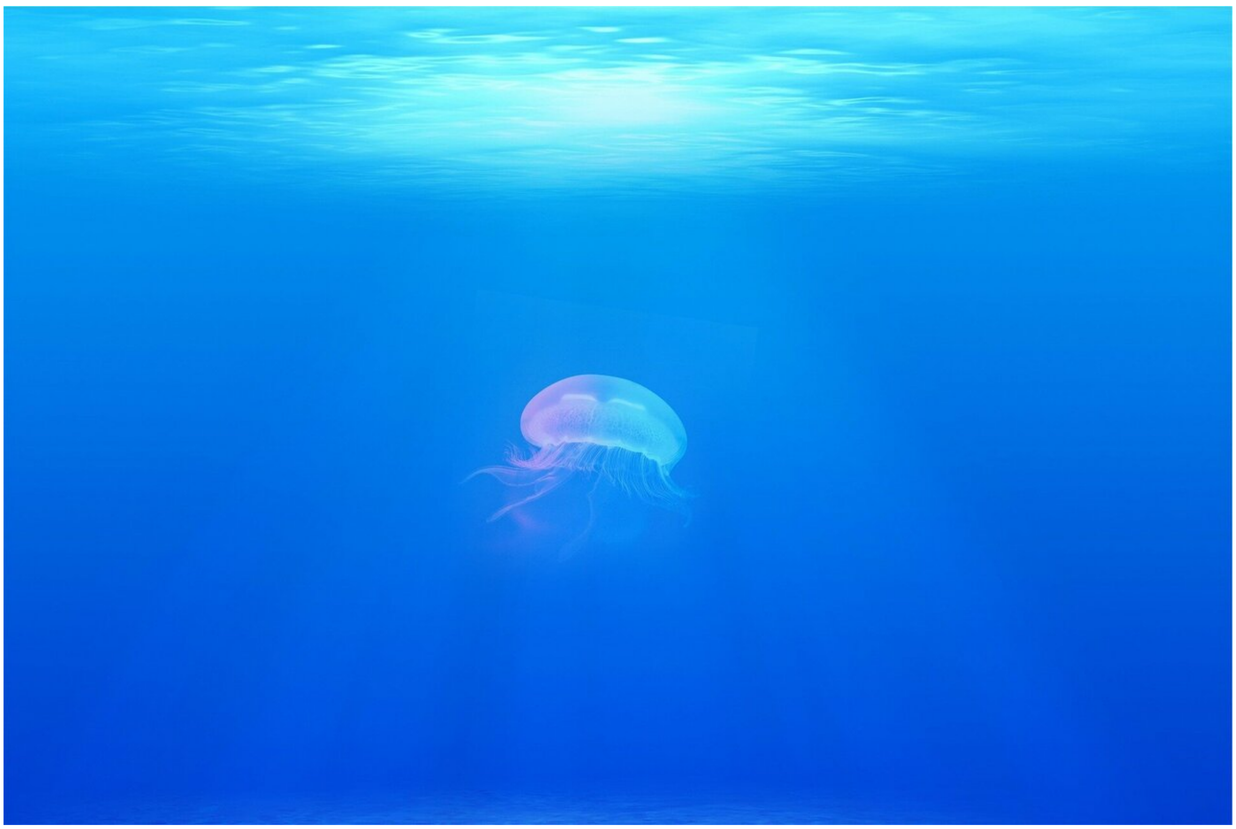
Changing resilience of oceans to climate change

January 15 2021



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Oxygen levels in the ancient oceans were surprisingly resilient to climate change, new research suggests.

Scientists used geological samples to estimate ocean oxygen during a period of global warming 56 million years ago—and found "limited expansion" of seafloor anoxia (absence of oxygen).

Global warming—both past and present—depletes ocean oxygen, but the new study suggests warming of 5°C in the Paleocene Eocene Thermal Maximum (PETM) led to anoxia covering no more than 2% of the global seafloor.

However, conditions are different today to the PETM—today's rate of carbon emissions is much faster, and we are adding nutrient pollution to the oceans—both of which could drive more rapid and expansive oxygen loss.

The study was carried out by an international team including researchers from ETH Zurich, the University of Exeter and Royal Holloway, University of London.

"The good news from our study is that the Earth system was resilient to seafloor deoxygenation 56 million years ago despite pronounced global warming," said lead author Dr. Matthew Clarkson, of ETH Zurich.

"However, there are reasons why things are different today.

"In particular, we think the Paleocene had higher atmospheric oxygen than today, which would have made anoxia less likely.

"Additionally, human activity is putting more nutrients into the ocean through fertilisers and pollution, which can drive oxygen loss and accelerate environmental deterioration."

To estimate ocean oxygen levels during the PETM, the researchers analysed the isotopic composition of uranium in ocean sediments, which tracks oxygen concentrations.

Surprisingly, these barely changed during the PETM.

This sets an upper limit on how much ocean oxygen levels could have changed.

Computer simulations based on the results suggest a maximum ten-fold increase in the area of seafloor devoid of oxygen—taking the total to no more than 2% of the global seafloor.

This is still significant, at around ten times the modern area of anoxia, and there were clearly detrimental impacts and extinctions of marine life in some parts of the ocean.

Co-author Professor Tim Lenton, Director of Exeter's Global Systems Institute notes: "This study shows how the resilience of the Earth's climate system has changed over time.

"The order of mammals we belong to—the primates—originated in the PETM. Unfortunately, as we primates have been evolving for the last 56 million years, it looks like the oceans have been getting less resilient."

Professor Lenton added: "Although the oceans were more resilient than we thought at this time in the past, nothing should distract us from the urgent need to reduce emissions and tackle the climate crisis today."

The paper, published in the journal *Nature Communications*, is entitled: "Upper limits on the extent of seafloor anoxia during the PETM from uranium isotopes."

More information: "Upper limits on the extent of seafloor anoxia during the PETM from uranium isotopes." *Nature Communications*

(2021). DOI: 10.1038/s41467-020-20486-5

Provided by University of Exeter