# Land-sea 'tag-team' devastated ocean life millions of years ago, reveal scientists

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Scientists unearth oceans and continents "tag-team" devasted life millions of years ago. Credit: University of Southampton

Scientists have revealed how a "tag-team" between the oceans and continents millions of years ago devastated marine life—and altered the course of evolution on Earth.

Their study has unearthed a new explanation for a string of severe environmental crises, called oceanic anoxic events, which happened between 185 and 85 million years ago. These occurred when the seas became critically depleted of dissolved oxygen.

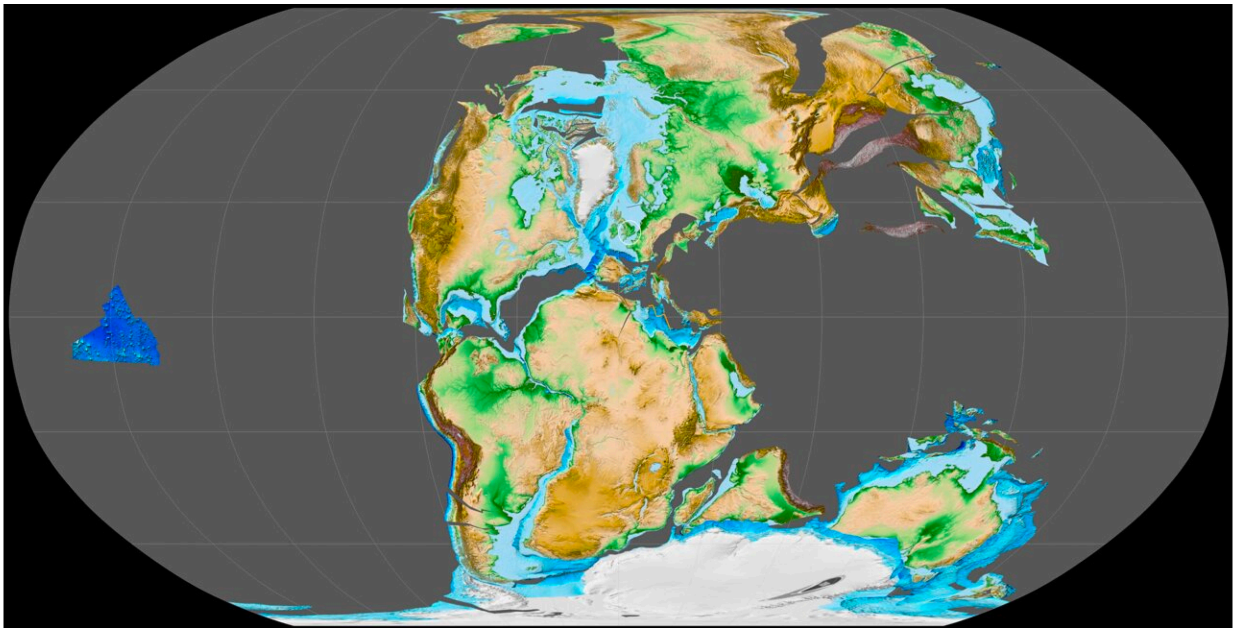
Experts from the University of Southampton, which led the study, said these events triggered significant biological upheavals, including mass extinctions of marine species. The findings are published in *Nature Geoscience.*

Lead author Tom Gernon, a Professor of Earth Science at Southampton, said, "Oceanic anoxic events were like hitting the reset button on the planet's ecosystems. The challenge was understanding which geological forces hit the button."

The study was undertaken by Southampton in collaboration with academics from the universities of Leeds, Bristol in the UK, Adelaide in Australia, Utrecht in the Netherlands, Waterloo in Canada, and Yale in the US. The researchers examined the impact of plate tectonic forces on ocean chemistry during the Jurassic and Cretaceous Periods, collectively known as the Mesozoic era.

This chapter of Earth's history is often dubbed the age of the dinosaurs, said Prof Gernon, and is famously exposed along the Jurassic Coast on the UK's south coast as well as along the cliffs of Whitby in Yorkshire and Eastbourne in East Sussex.

The team combined statistical analyses and sophisticated computer models to explore how chemical cycles in the ocean could have feasibly responded to the breakup of the supercontinent Gondwana, the great landmass once roamed by the dinosaurs.



Gondwana supercontinent once roamed by the dinosaurs. Credit: University of Southampton

Prof Gernon said, "The Mesozoic era witnessed the breakup of this landmass, in turn bringing intense volcanic activity worldwide. As tectonic plates shifted and new seafloors formed, large amounts of phosphorus, a nutrient essential for life, were released from weathering volcanic rocks into the oceans.

"Crucially, we found evidence of multiple pulses of chemical weathering on both the seafloor and continents, which alternately disrupted the oceans. It's like a geological tag-team."

Experts from the universities found the timing of these weathering pulses matched up with most oceanic anoxic events in the rock record. They propose that the weathering-related influx of phosphorus to the ocean acted like a natural fertilizer, boosting the growth of marine organisms.

However, the researchers said these fertilization episodes came at a major cost for marine ecosystems. The increase in biological activity led to huge amounts of organic matter sinking to the ocean floor, where it consumed large quantities of oxygen, said co-author Benjamin Mills, a Professor of Earth System Evolution at the University of Leeds.

He added, "This process eventually caused swathes of the oceans to become anoxic, or oxygen-depleted, creating 'dead zones' where most marine life perished.

"The anoxic events typically lasted around one to two million years and had profound impacts on marine ecosystems, the legacy of which are even felt today.

"The rocks rich in organic matter that accumulated during these events are by far the largest source of commercial oil and gas reserves globally."

As well as explaining the cause of extreme biological turmoil in the Mesozoic, the study's findings highlight the devastating effects that nutrient overloading can have on marine environments today.

The team of researchers explained how present-day human activities have reduced mean oceanic oxygen levels by about two percent—leading to a significant expanse in anoxic water masses.

Prof Gernon said, "Studying geological events offers valuable insights that can help us grasp how the Earth may respond to future climatic and environmental stresses."

Overall, the team's findings reveal a stronger-than-expected connection between the Earth's solid interior and its surface environment and biosphere, especially during periods of tectonic and climatic upheaval.

"It's remarkable how a chain of events within the Earth can impact the surface, often with devastating effects," added Prof Gernon. "Tearing continents apart can have profound repercussions for the course of evolution."

**More information:** Solid Earth forcing of Mesozoic oceanic anoxic events, *Nature Geoscience* (2024). DOI: 10.1038/s41561-024-01496-0

Provided by University of Southampton

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