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The Dinosaur-Killing Asteroid Acidified the Ocean in a Flash

The Chicxulub event was as damaging to life in the oceans as it was to creatures on land, a study shows.

An illustrator's impression of the Chicxulub impact crater soon after its creation. Credit...Detlev van Ravenswaay/Science Source

By Lucas Joel Published Oct. 21, 2019Updated Oct. 24, 2019

What happened to the dinosaurs when an asteroid about six miles wide struck Earth some 66 million years ago in what is today Mexico is well known: It wiped them out. But the exact fate of our planet's diverse ocean dwellers at the time — shelly ammonites, giant mosasaurs and other sea creatures — has not been as well understood.

New research now makes the case that the same incident that helped bring an end to the reign of the dinosaurs also acidified the planet's oceans, disrupted the food chain that sustained life underwater and resulted in a mass extinction. The study, published Monday in Proceedings of the National Academy of Sciences, aims to shore up the hypothesis that the Chicxulub event's destruction of marine life — the result of sulfur-rich rocks depositing acid rain into the oceans —

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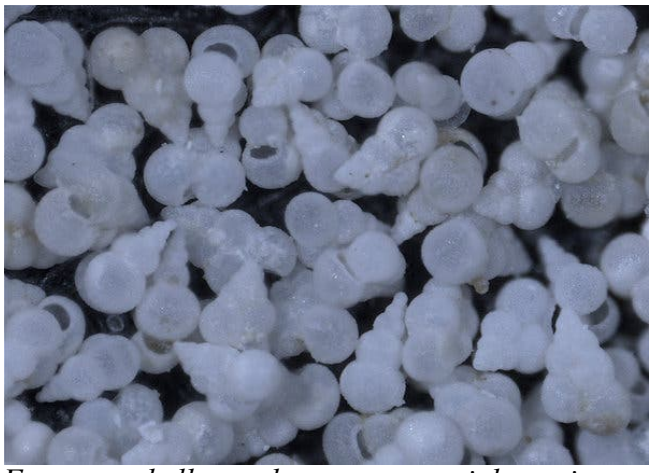
was just as severe as the fire and fury it brought to land.

“It’s flash acidification, and it transformed ecosystems for millions of years,” said Noah Planavsky, a biogeochemist at Yale and one of the study’s authors. “We were shocked that we actually found this.”

The impact of the Chicxulub asteroid — so named for the crater it carved out around the Gulf of Mexico — sent columns of rock into Earth’s atmosphere, incinerated the planet’s forests and drove tsunamis far across the oceans. But the connection between the crash and the marine extinction has been less solid.

That gap in understanding was on the mind of Michael Henehan, a geochemist, when he attended a conference in 2016 in the Netherlands that included a group outing to the cave system at Geulhemmerberg, which contains stones from the end of the Cretaceous period. There, he came upon a surprisingly thick rock layer made of gray clay that formed just after the asteroid hit. Lacking proper rock sample bags, he emptied the contents of his lunch into his pockets, collected some rocks and put them into his lunch bags.

Back in the lab at Yale University, Dr. Henehan, who is now a researcher at GFZ Helmholtz Center in Potsdam, Germany, cleaned the rocks and found the fossil shells of thousands of tiny marine plankton called foraminifera, or “forams.” Finding so many shells was fortunate, he explained, because they preserve trace amounts of boron, a chemical element that is sparse in such fossils, but offers clues to the ancient acid levels of the oceans when enough of it can be found.



Foram shells, shown at eight times magnification, collected in the Geulhemmerberg caves in the Netherlands. They offered clues to the ocean’s acid levels after the asteroid struck. Credit...Michael J. Henehan

Dr. Henehan and his team measured the boron, and found that the relative proportions of two isotopes of the element changed abruptly right at the time of the impact. In shells like these, Dr. Planavsky explained, proportions of the boron isotopes shift when the acidity of the oceans rises. And because this ancient shift happened in the first 100 to 1,000 years after the impact, it means the oceans became acidic practically overnight.

The flash acidification would have devastated organisms that formed the foundations of ecosystems, leading to problems for other creatures like the ammonites that lived higher up the food chain.

“This is a big leap forward,” said Chris Lowery, a paleoceanographer at the University of Texas at Austin who was not involved in the new work.

The study offers evidence of what sustained the marine extinction after the asteroid impact got things rolling. That, and it confirms that the asteroid triggered the extinction in the first place.

Around the time that the asteroid struck, there was intense volcanic activity in what is today India, causing over 200,000 cubic miles of lava to be disgorged over the course of about a million years. For a long time, it was not clear if the

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marine mass extinction stemmed from changes wrought by the volcanism or by the asteroid. But because the boron shift happened exactly at the boundary, it is now obvious that the asteroid had the bigger effect.

This is the boundary, visible in the rock of the Geulhemmerberg caves, that marks the transition from the Cretaceous period to the Paleogene. Credit...Michael J. Henehan

"It's very, very strong evidence that the ocean acidification was caused by the impact and not volcanoes," Dr. Lowery said.

The flash acidification and mass extinction, though ancient events, are relevant to our modern world. According to reports from the United Nations Intergovernmental Panel on Climate Change, human emissions of carbon dioxide are not only warming the planet, but also acidifying the oceans. And that modern acidification, Dr. Planavsky says, is happening at a rate and scale comparable to the asteroid-triggered acidification. A similar result, he said, "is on the extreme end of what we could get in the next 100 years."