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Did Asteroid-Induced Firestorm Destroy the Dinosaurs?

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Dinosaurs may have met their demise in a global firestorm of methane gas triggered by an asteroid impact, a team of scientists reports in the latest issue of *Geo-Marine Letters*.

The methane gas was released from the Earth by the asteroid collision and ignited by lightning, says Naval Research Laboratory scientist Barton Hurdle.

Hurdle told space.com that he and several colleagues put forth the idea -- a fiery end to Earth's greatest land creatures -- before various teams of researchers in 1991 and 1992 theorized that a crater discovered in Mexico was the site of an asteroid impact responsible for the mass extinctions.

"It shook up the ocean, generated tsunamis that ruptured pockets of methane that were trapped under gas hydrates, and it also created slumping -- a sliding down of the ocean bottom -- that released (the methane) too," Hurdle said.

"This stuff came out, lightning set it afire, and it burned," Hurdle explained. "There were fantastic quantities of this stuff."

The theoretical fire would have burned near the ground and high into the atmosphere, Hurdle said, enveloping much of the planet as shock waves from the impact moved through the planet and dislodged methane around the globe.

"The atmosphere itself would have been on fire," Hurdle and his colleagues wrote in the paper.

The fire would have incinerated land creatures, he said, while decreasing oxygen supplies and increasing the amount of carbon dioxide in the atmosphere.

"There was a lot of soot, and that soot has been found," Hurdle said.

The theory, also featured in this week's issue of *New Scientist* magazine, stems from the discovery of vast deposits of methane, a carbon-based molecule, under the sea floor that are locked in crystals of water ice, forming "methane hydrate."

Marine geologist Erwin Suess and co-workers from the Research Center for Marine Geosciences in Germany estimate the total amount of carbon locked in these deposits exceeds the amount in all of the known coal, oil and gas

reservoirs. What is more, methane hydrate is very unstable and releases methane if the temperature or pressure rises slightly above that existing under the seafloor.

Interest, and skepticism

Brown University's Peter Schultz, who studies impact craters and the processes that create them, says Hurdle's idea definitely merits further study.

"The observation that there are these methane traps on the bottom of the ocean is pretty well established," Schultz told space.com. He said that while an ocean impact could certainly release this methane, he's not sure if the affect would be over a large enough area to release enough methane to cause the scenario Hurdle describes.

"My reservation is whether or not the shock wave could have released as much methane as they say," Schultz said.

And as planetary scientists John Lewis and Sidney van Den Bergh point out, there are several other dire consequences of the impact, (the site is known as the Chicxulub crater), that could explain the extinction of the dinosaurs. The methane hydrate proposal is seen by many researchers as credible, but may in fact have been a nail in the coffin rather than the exact cause.

Evidence and likelihoods

There is ample evidence of a global firestorm at the time of the Chicxulub impact. Iridium-bearing clay in the boundary layer between the Cretaceous Period (a time when dinosaurs roamed) and Tertiary Period (the subsequent geologic time frame when dinosaurs seem to have disappeared) contains soot.

The quantity and composition of the soot corresponds to the burning of at least 50 percent of the world's forests. Although Hurdle's idea that methane fires were responsible for this firestorm is plausible, there is another simpler explanation.

The Chicxulub impact would have launched millions of tons of rock into ballistic space flight. Over the following hour this debris would have re-entered the Earth's atmosphere at high speed, causing millions of brilliant "shooting stars." The radiant heat from these meteors alone would have been sufficient to ignite the trees around the world.

This idea is supported by the discovery of charcoal in tsunami deposits near the impact site. The best explanation may be that the trees were ignited by radiant heat, then swamped soon after by the waves.

The shock wave from the impact would indeed have triggered massive earthquakes in the region and indirectly triggered other earthquakes around the globe. A tsunami would have formed from the impact, which occurred in a shallow sea. The giant waves would also have been generated by the earthquakes and undersea landslides triggered by the shock wave.

"Megawaves emanating from an impact site would circuit the earth at high speeds and cause worldwide disruption in the entire ocean in a single day," Hurdle and his colleagues wrote.

Acid rain and a long, long winter

Researchers say the impact fireball and the forest fires would have created huge quantities of nitrogen oxides, which react with water vapor to form acid rain. By chance, the Chicxulub asteroid struck rocks with an unusually large proportion of calcium sulfate. This would have generated sulfur dioxide -- another source of acid rain. There are several signs of a massive dose of acid rain at the time, including sudden weathering of continental rocks.

The dust thrown up by the impact, the soot generated by the firestorms and the smog formed from the oxides of nitrogen and sulfur particles would have blocked sunlight for many months. The surface of the Earth would have plunged to freezing conditions -- typically 70 degrees Fahrenheit below normal -- and photosynthesis would not have been possible, even if plants had survived the fires and acid rain.

Global warming

After several months the dust would have settled and sunlight would have begun heating up the land. Now the greenhouse effect would have taken over due to the excess of carbon dioxide created by the fires and the melting of limestone rocks at the impact site.

Methane released from ocean sediments could have added to the greenhouse effect. It has been estimated that the surface temperatures on Earth were at least 10 degrees Fahrenheit above normal for hundreds of thousands of years after the impact.

So dinosaurs, if they were not consumed in a firestorm, would have had to live through a torturous sequence of events -- from the barbecue to the freezer, to a dip in acid and then a hothouse baking. Regardless of whether Hurdle's idea is correct, it agrees with mounting evidence that suggests how a massive asteroid impact at Chicxulub may have been the fatal blow to the dinosaurs, as well as 50 percent of all the Earth's species.

space.com's Robert Roy Britt contributed to this report

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