Volcanoes Triggered Ancient Warming Event

By Ker Than
LiveScience Staff Writer
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The same volcanic eruptions that sundered Greenland from Western Europe and created Iceland also triggered intense global warming 55 million years ago, scientists say.

“There has been evidence in the marine record of this period of global warming, and evidence in the geologic record of the eruptions at roughly the same time,” said study team member Robert Duncan, an oceanic scientist at Oregon State University, “but until now there has been no direct link between the two.”

During the Paleocene-Eocene Thermal Maximum (PETM), massive amounts of greenhouse gases were injected into the oceans and atmosphere, causing global sea surface temperatures to rise by up to 10 degrees Fahrenheit.

The event changed global rainfall patterns, broiled and acidified the oceans, and killed up to 50 percent of the world’s deep-sea organisms. The warm climate also opened up new migration routes for horses and other mammals into North America and might have even fueled early primate evolution.

The PETM took roughly 100,000 years to peak, and it was another 100,000 years or so before the climate recovered. What triggered the PETM has been a topic of intense speculation by scientists. Theories have ranged from the extensive burning of peat and coal deposits to an impact by a carbon-rich comet.

Matching ash

In the new study, detailed in the April 27 issue of the journal Science, the researchers linked the PETM to volcanic eruptions occurring from 55 to 61 million years ago. Back then, Greenland was still fused to Europe as part of one vast supercontinent, and the Northern Atlantic Ocean did not exist yet.

The team matched the chemical composition and deposition date of ash layers in East Greenland amassed during the peak of the eruptions with ash found in marine sediments in the Atlantic Ocean.

The scientists speculate magma and hot outgassing from the North Atlantic volcanism heated decaying organic material rich in carbon deposited in low-lying basins.

“The hot magma worked its way up through the crust and invaded these basins, essentially cooking all this stuff and liberating a lot more greenhouse gases than was actually coming from the magma itself,” Duncan explained.

Only a trigger

But the volcanism was only a trigger. All the greenhouse gas emitted by the eruptions and the ensuing cooking of organic matter would still not have been enough to cause the changes in climate and ocean chemistry seen during the PETM.

Other scientists have proposed the North Atlantic volcanism might have warmed the oceans enough to liberate methane trapped in icy sediments—called "methane hydrate"—on the ocean floor.

"Volcanism could have served as a trigger to start the system moving toward warmer temperatures," said James Zachos, a paleo-oceanographer at University of California, Santa Cruz. "Then the ocean passes some threshold for hydrate stability, and the hydrate starts to decompose."

Zachos, who was not involved in the new study, called the findings the most compelling evidence yet for explaining the PETM.

Volcanic activity similar to that implicated in the PETM still occurs in regions like Yellowstone National Park and the Galápagos and the Hawaiian Islands.

"These hotspots are part of the everyday world," Duncan told LiveScience. "It's just that we don't have volcanic events as catastrophic as what [occurred] in the North Atlantic on a continual basis. Thank God too, because it would be a very different world."

Today's global warming

Research on the PETM not only sheds light on Earth's ancient climate, but also provides clues about the potential long-term consequences of our current global warming.

The PETM is "one of the few examples in the natural record where we get changes in chemistry and temperature that are approaching what we're seeing today," Duncan said.

The United Nations recently released an authoritative report that concluded human activity could cause atmospheric temperatures to rise up to 11 degrees Fahrenheit by the close of the century.

Our species might achieve in 100 years what took 100,000 years to happen naturally. And if the PETM is any indication, Duncan said, it will also take our planet about that long to recover.