Northumbria University NEWCASTLE

Illuminated buildings in Riposto, Italy, during Etna eruption. Credit: EyeEm Mobile GmbH/Getty Images.

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Ancient volcanoes released ‘cryptic’ carbon dioxide far longer than previously believed

Ancient volcanoes continued to eject carbon dioxide into the atmosphere for millions of years after their eruptions ended, researchers have discovered.

A series of tremendous volcanic eruptions in Siberia led to Earth’s most severe mass extinction, more than 250 million years ago. The Earth's climate took nearly five million years to stabilise after these eruptions according to climate records, far longer than expected based on current scientific understanding.

But now a discovery of ‘cryptic carbon’ emissions has solved this long-standing mystery, identifying a hidden source of carbon dioxide in the atmosphere during times when the Earth has warmed abruptly.

The findings have been published in the prestigious journal Nature Geoscience.

An international team of geoscientists, including Dr Jack Longman from Northumbria University’s Department of Geography and Environmental Sciences, set out on a major study to understand what caused prolonged episodes of warming during turning points in Earth’s climate history.

The team compiled chemical analyses of the lavas, developed computer models simulating melting inside the Earth, and compared the results with records of past climate preserved in sedimentary rocks.

They found evidence that carbon dioxide emissions could last millions of years after most surface eruptions had ended.

Although eruptions may have stopped on the surface, carbon dioxide was still being released from magma deep in the crust and mantle – a phenomenon they called "cryptic degassing" – which led to prolonged climate warming.

The research team say the findings are significant because they identify a hidden source of atmospheric carbon dioxide and highlight not only an important piece of the puzzle for how Earth's climate was disrupted, but just as importantly, how it recovered.

Dr Jack Longman, an Assistant Professor in Geography and Environmental Sciences at Northumbria University, worked as part of the team modelling the impact of the volcanic activity on Earth.

He explained: "Traditionally it has been assumed that during these large volcanic eruptions, the climatic warming resulting from them was offset by cooling, driven by the eruption of the lava itself.

"Lava is easily eroded, and when it erodes, chemical reactions which remove carbon dioxide from the atmosphere occur. This is a natural climate control system – almost like Earth's own thermostat – so the extended warming we had seen had left scientists a little baffled.

"We found that amount of carbon dioxide continuing to be released via what we have called 'cryptic degassing' caused an apparent failure of one of the natural thermostats which controls Earth's climate, explaining the extended periods of warmth post enormous volcanic eruptions.

"Although the chemical reactions to draw down carbon from the atmosphere were occurring, we were able to assess why this apparent natural thermostat did not function at times. In essence, the amount of carbon being drawn down was negligible when compared to the amount still being released from deep inside the volcanos."

If volcanoes kept "turning the temperature up" long after their eruptions were believed to be over it could mean the Earth's thermostat may work better than scientists thought.

The team emphasised that ‘cryptic’ carbon from volcanoes cannot explain present-day climate change but that they hope to learn about current and future climate responses from these past eruptions.

These findings are the beginning of a multi-year effort funded by the National Science Foundation to investigate how cryptic carbon could influence recovery after major disruptions of Earth’s climate.

The study was led by Rutgers University in New Jersey, USA, and involved researchers from the Universities of Oregon, California-Davis, Adelaide, Leeds and Oxford.

Dr Longman is a member of Northumbria University’s Environmental Monitoring and Reconstruction (EnMaR) research group which studies modern and ancient environments, from the tropics to the polar regions, and seeks to answer fundamental global questions about climate and the environment.

The paper Cryptic degassing and protracted greenhouse climates after flood basalt events is now available in Nature Geoscience.

Press release adapted with thanks to Rutgers University.

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