Volcanic activity and low ocean oxygen events linked to climate warming and rapid ice melt during last ice age

November 2 2022, by Michelle Klampe

Credit: CC0 Public Domain

A chemical analysis of sediment cores from the North Pacific Ocean show a consistent pairing of volcanic ash and hypoxia, a low ocean

oxygen condition spanning thousands of years, during times of rapid climate warming at the end of the last ice age, new research published today in *Nature* shows.

Understanding the relationship among volcanic activity, hypoxia and ice melt due to warming temperatures during the last ice age, which ended about 18,000 years ago, raises important questions about what might occur as the planet warms today.

"It is unknown right now whether volcanic eruptions will increase as the climate warms," said the study's lead author, Jianghui Du of ETH Zurich in Switzerland, who conducted the research as a doctoral student at Oregon State University's College of Earth, Ocean, and Atmospheric Sciences.

"But we know that the remaining glaciers on volcanoes in the Pacific Ocean ring of fire are melting fast, and it will be important to include this ice loss in predictions of future eruptions, which would be risky for populated regions and could also make emerging hypoxic dead zones in the North Pacific worse."

The findings point to a systematic relationship among climate, glacier retreat, volcanic activity, biological productivity and deoxygenation of the ocean, said Alan Mix, an oceanographer and paleoclimatologist at Oregon State and a co-author of the paper.

"These surprising linkages between parts of the Earth we usually think of as separate highlight how interconnected the whole system really is," he said. "Solving environmental problems, such as those we face in the ongoing climate crisis, demands that we look with open minds at the whole linked system and not just at isolated parts."

The volcanic region in the Pacific Ocean is known as the ring of fire in

part because it is one of the most active tectonic and volcanic regions of the world.

The timing of volcanic events in relation to the retreat of the Cordilleran Ice Sheet, which once covered large portions of western North America, suggests that the rapid melting of ice covering volcanoes in the region induced increased volcanic activity, Mix said.

"Ice cover to volcanoes is like a cork in a champagne bottle. Remove the icy cork and boom, the eruptions begin," he said.

Past research had shown a few ash layers in sediment in the region, but Du's chemical study, using deep-sea sediment cores from the Gulf of Alaska, revealed more traces of ash that were not visible to the eye.

Du catalogued and compared volcanic eruptions from areas that were covered in ice against those areas that were not ice-covered during the last ice age.

"We found a distinct pattern of many eruptions during warming and ice retreat in the areas where glaciers were present, and much less change in the frequency of eruptions outside the ice-covered zone, particularly in western North America," Du said. "That provides strong evidence for the volcanic response to warming and ice retreat."

The chemical fingerprints also showed a consistent pairing of volcanic ash and hypoxic events. The increase in volcanic ash likely fueled ocean productivity that ultimately created low-oxygen conditions.

Co-authors from Texas A&M University, Christina Belanger and Sharon (who uses only one name) examined a species of seafloor organisms called foraminifera and found that they closely tracked the volcanic ash input from the Gulf of Alaska. These organisms thrive under highly

productive waters and can tolerate low oxygen conditions.

"Volcanic ash includes important trace nutrients for plankton, especially iron," said co-author Brian Haley, a research professor at Oregon State.

"When the ash hits the ocean, the plant plankton gobble up that iron and bloom. This fertilization effect underscores a practical application of our work. Some have proposed fertilizing the North Pacific with iron to capture excess carbon dioxide from the atmosphere," he said.

"We show that the real world has effectively run that experiment in the past with volcanic iron, and the fertilization effect works and exports carbon to the deep sea. That's good news. But there are some dangerous consequences because when that excess organic matter decomposes as it falls to the ocean depths, it consumes oxygen and creates dead zones."

More information: Jianghui Du, Volcanic trigger of ocean deoxygenation during Cordilleran ice sheet retreat, *Nature* (2022). DOI: 10.1038/s41586-022-05267-y. www.nature.com/articles/s41586-022-05267-y

Provided by Oregon State University

Citation: Volcanic activity and low ocean oxygen events linked to climate warming and rapid ice melt during last ice age (2022, November 2) retrieved 23 June 2024 from https://phys.org/news/2022-11-volcanic-ocean-oxygen-events-linked.html