Volcanic eruptions may affect oceanic microbial processes

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Extensive, explosive volcanic eruptions may disrupt a crucial aspect of the global nitrogen cycle, say researchers who have investigated ash deposits on the ocean floor.

The study, published in *Environmental Microbiology* Reports, assessed how volcanic dust or ash affects microbes living in deep-sea sediments. Researchers were particularly interested in those that get their energy using anammox metabolism. This is a respiratory process in which bacteria combine nitrite and ammonium compounds from sediments and convert them into nitrogen gas.

Wastewater treatment plants use this process to remove ammonium and nitrate from effluent, making it less likely to cause toxic algal blooms in the environment.

The team studied sediment cores that had been taken out of the ocean floors near the Island of Montserrat in the Lesser Antilles to see whether there was more evidence of microbes using the anammox process, or of another respiratory process called denitrification.

'We were interested in how volcanic ash that was deposited from Montserrat volcano changed the composition of sediments in the water around the area and how it alters nitrogen pathways,' explains Dr Bongkeun Song of the Virginia Institute of Marine Science,who led the research.

'In deep-sea sediments not affected by volcanic ash, we saw a high percentage of nitrogen gas that had been produced by the anammox process. But when we went to a site with high amounts of volcanic ash we saw that both anammox and denitrification were supressed,' says Song.

Unlike denitrification, which can produce greenhouse gasses such as nitrous oxide and carbon dioxide alongside harmless nitrogen gas, anammox is capable of fixing carbon dioxide to organic carbon in the sediments, effectively trapping it, and removing it from the atmosphere.

By inhibiting annomox, past extensive explosive volcanism may have led to an increase in greenhouse gases.

The Earth has experienced long periods of volcanic activity in the past. Around the time the dinosaurs went extinct, massive volcanic activity in a region called the Deccan Traps lasted about one and a half million years. Indeed, such activity has led some scientists to suggest this contributed to the demise of the dinosaurs.

The researchers were surprised to find that the anammox process was also lower since they expected the high ammonia content of volcanic ash

to mean microbes using anammox were favoured.

'The volcanic ash has lots of metal and some ammonium, but it actually also contains a lot of iron which can react with nitrate and so inhibit both the denitrification and anammox processes,' Song says.

The study was conducted on NERC's RRS James Cook by a research crew investigating the volcanic ash surrounding Montserrat volcano.

More information: Song, B., Buckner, C. T., Hembury, D. J., Mills, R. A. and Palmer, M. R. (2014), "Impact of volcanic ash on anammox communities in deep sea sediments." *Environmental Microbiology* Reports, 6: 159-166. DOI: 10.1111/1758-2229.12137