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An abrupt decrease in atmospheric oxygen by massive release of hydrogen sulfide during the end-Permian mass extinction

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The largest turnover of animals and plants in both ocean and land occurred in the end of the Permian, 252 million years ago. Understanding the cause of this mass extinction of life is important to understanding the evolution of life on Earth. Previously suggested causes of this major event cannot explain all of the characteristics of the mass extinction. Here we show that an abrupt decrease in atmospheric oxygen could have caused the mass extinction. Coincidental negative shifts of sulfur isotope ratios ($^{34}S/^{32}S$) of carbonate-associated sulfate in the shallow seas and of sulfide in the deep ocean, as well as biomarker evidence, imply that mixing of H_2S (accumulated in the ocean) and O_2(in the ocean and/or atmosphere) occurred during 20,000-year interval coinciding with the end-Permian mass extinction. In the case of a massive release of H_2S to the atmosphere, our box-model calculations (based on the chemical reactions of sulfur, CH_4, and inorganic molecules in the troposphere) indicate that the oxidation of the H_2S caused a significant decrease - up to 30% - in atmospheric O_2coinciding with the mass extinction. H_2S accumulation in the ocean followed by abrupt its massive release may have maintained low atmospheric O_2during much early Earth history: 3 to 1 billion years ago. This mechanism could have delayed evolution, not allowing development beyond single cells during the 3 billion years after the birth of life.

Keywords: end-Permian, mass extinction, hydrogen sulfide, atmospheric oxygen, sulfur isotope ratio, biomarker