Study reveals new mechanism for end-Permian terrestrial mass extinction

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The end-Permian extinction (EPE) was the greatest biotic crisis in Earth's history, eliminating more than 90% of species in the oceans and more than 70% of species on land.

Researchers led by Dr. Li Menghan from the University of Science and Technology of China (USTC) of the Chinese Academy of Sciences conducted a S-isotopic study on EPE in the Sydney Basin, and found that a sharp S-isotopic decrease coincided with the terrestrial extinction.

They discovered climatic perturbations of short-term cooling caused by sulfate aerosols, along with longer-term global warming. "Their interactions may have contributed to the EPE on land," said Dr. Li.

Related results were published in *Earth and Planetary Science Letters* on June 1.

Regarding the study of the environment and the mechanism of the EPE, many studies have focused on the extinction of marine organisms and their mechanisms, while studies on the extinction of terrestrial life are rare.

In this study, the research team conducted detailed measurements and multiple data analyses of more than 1,000 meters of boreholes and associated stratigraphy to first pinpoint the stratigraphy of terrestrial organisms extinct in the Sydney Basin. The data indicated that the extinction of terrestrial organisms in the Sydney Basin preceded the global marine extinction by approximately 200,000 to 600,000 years.

On this basis, the team suggested that the high pre-extinction S-isotopic compositions of pyrite from the Sydney Basin may have been produced by similar sulfur cycling processes in sulfate-deficient lake systems. A sharp S-isotopic decrease coincided with the terrestrial extinction, which was manifested in three stages.

"The dominant source for the elevated sulfate concentrations in the extinction interval came from the dispersal of atmospheric sulfate aerosols emitted by the Siberian Traps volcanism," said Dr. Li. The

fallout of sulfuric acid rain resulting from the Siberian Traps Large Igneous Province (STLIP) may have raised the sulfate concentrations in the Sydney Basin, which coincided with the EPE on land. Climatic perturbations of short-term cooling caused by the sulfate aerosols, along with longer-term global warming and their interactions, have contributed to the EPE on land.

The S-isotopic data from the well-defined biostratigraphy and precise geochronology of the Sydney Basin provide new and independent evidence for the massive deposition of atmospheric sulfate, which may play a critical role in the EPE on land.

More information: Menghan Li et al, Sulfur isotopes link atmospheric sulfate aerosols from the Siberian Traps outgassing to the end-Permian extinction on land, *Earth and Planetary Science Letters* (2022). DOI: 10.1016/j.epsl.2022.117634

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