Geochemical analysis of Chinese rocks used to better understand the Permian-Triassic mass extinction

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Field photograph of the Permian-Triassic boundary (PTB) section at Xiakou, Hubei Province, South China.

(Phys.org)—University of Cincinnati professor Thomas J. Algeo, working with a team of Chinese scientists, has established a tight link between repeated episodes of volcanic activity and environmental degradation leading up to the deadliest extinction in Earth's history.

In a paper published in the November 2012 issue of the journal *Geology*, Algeo and colleagues from the China University of Geosciences track patterns of carbon isotope ratios associated with volcanic ash layers preserved in southern China rock layers. In particular, the team looked at two rock successions preserving finely layered marine deposits that record volcanic activity from before the end of the Permian period (252

million years ago) through the early part of the next geologic period, the Triassic. These successions contain layers recording events during the crisis that resulted in the extinction of some 90 percent of marine species on Earth.

"These sections have not been studied in detail geochemically," Algeo said. "Because they are deep-marine deposits, they record a very detailed and complete sequence of events. This is something you generally don't find in terrestrial or shallow-marine rocks."

The evidence, Algeo said, demonstrates a volcanic cause of the end-Permian crisis. Volcanic activity contributed to the environmental degradation that accompanied the main extinction horizon at the end of the Permian.

Some researchers have hypothesized that the biotic crisis and mass extinction were caused by the Siberian Traps, a large flood basalt province that erupted approximately 252 million years ago, coinciding more or less with the mass extinction. "This connection has been inferred on the basis of similarities in age and, thus, is circumstantial," Algeo said.

"We demonstrate for the first time that the Permian-Triassic biotic crisis was probably triggered by enormous explosive volcanic eruptions," Algeo said. "We suspect that the ash layers in the Chinese PTB sections are linked to the Siberian Traps, although more research will be needed to verify this."

At the heart of their analysis, the co-authors identify significant changes in the ratio of carbon isotopes at each ash layer in the Chinese sections. This implies large releases of isotopically light, organically derived carbon dioxide or methane with each eruptive event. "This is consistent with large-scale injection of magma into the organic-rich sediments of

the West Siberian coal province," Algeo said.

According to Algeo, the Chinese deposits have to potential to clarify the mechanisms that almost wiped out all life on Earth 252 million years ago, and to help in better constraining the timing of the Siberian Traps eruptions.

In earlier research at a variety of locations around the globe, Algeo had compiled evidence that the Permian-Triassic extinction, unlike the more famous Cretaceous-Tertiary extinction in which the large dinosaurs went extinct, was a gradual process. The final extinction event may have been preceded by hundreds of thousands of years of environmental stress. The China research supports this hypothesis of gradual steps toward a dramatic extinction event. The accumulating evidence, he said, points to a very different mechanism, and a far more devastating result, than the end-Cretaceous bolide impact.

"It's becoming clear that almost every mass extinction has a different cause," Algeo said.

More information: geology.gsapubs.org/content/current

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