Constraining drivers of the End-Permian Mass Extinction using high-resolution records of marine anoxia

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The End-Permian Mass Extinction (EPME) was the most severe biotic crisis of the Phanerozoic. Although the basic architecture of events surrounding the EPME appears to be growing clear, the detailed timing and relative importance of various kill mechanisms remain a matter of debate. Determining exactly how the extinction unfolded is a crucial test of our understanding of the biogeochemical dynamics and chain of causality.

To better understand the precise timing of ocean anoxia associated with the EPME, we compiled published $\delta^{238/235}U$ records from Dawen, Dajiang, and Taşkent (all located in the Tethys) along with a new unpublished Panthalassic section from Kamura, Japan. These sections were temporally correlated to the precisely dated Meishan section using a combination of $\delta^{13}C$ records and conodont biostratigraphy.

We combined this new high-resolution composite $\delta^{238/235}U$ data set with an isotopic box model and Monte Carlo framework to quantify the extent of seafloor anoxia through time while formally considering combined sources of error from the data, chronology, and modeling. Our preliminary modeling results indicate that the most probable explanation for the observed decrease in $\delta^{238/235}U$ is an abrupt and short (~10 kyr) but intense increase in marine anoxia covering 30-90% of the total ocean floor that was coeval with the main EPME extinction horizon. Following this event, most simulations display a similarly brief (~10-20 kyr) period of recovery to near pre-extinction conditions. This was finally followed by a protracted (>300 kyr) period of moderately increased anoxia.

The rapid onset and possible fluctuations in marine anoxia during the EPME place strong constraints on the timing, duration, and magnitude of potential forcings, including global climate, enhanced weathering, and ocean circulation changes. We will examine implications for several volcanism-related hypotheses and discuss opportunities to integrate our results with Earth System Models to provide more comprehensive tests of possible scenarios.