Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29420

Rapid marine redox oscillations precipitated the End-Permian mass extinction: evidence from iron isotope stratigraphy

QI JU[1], YI-BO LIN[2], FEIFEI ZHANG[2], HUA ZHANG[3] AND SHUZHONG SHEN[4]

[1]School of Earth Science and engineering, Nanjing University
[2]Nanjing University
[3]Nanjing institute of Geology and Palaeonotology, Chinese Academy of Science
[4]School of Earth Sciences and Engineering and Frontiers Science Center for Critical Earth Material Cycling, Nanjing University, Nanjing 210023, China

The End-Permian Mass Extinction (EPME), the most severe biocrisis in Earth's history, has been widely linked to marine anoxia. However, controversies persist regarding the onset timing, spatial extent, and driving mechanisms of oceanic deoxygenation. Here we present high-resolution iron isotope records from the Permian-Triassic boundary stratotype at Meishan, revealing three distinct negative $\delta^{56}Fe$ excursions at ~50 kyr pre-EPME, ~4 kyr pre-EPME (coinciding with the pyrite bed), and during the EPME interval, corresponding to alternating anoxic-euxinic conditions. Significantly, two rapid $\delta^{56}Fe$ recoveries between these excursions indicate transient oxygenation episodes. We propose these intermittent oxygenation pulses resulted from climate perturbations driven by SO_2-induced volcanic winters, leading to vertical fluctuations of photic-zone euxinia (PZE). Our findings demonstrate a rapid oscillatory pattern of marine redox conditions characterized by phased PZE expansion and contraction during the pre-EPME interval. This dynamic redox instability, rather than persistent anoxia, likely imposed escalating environmental stresses on marine biotas, ultimately culminating in the catastrophic EPME.