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Marine productivity variations and environmental perturbations across the Early Triassic Smithian-Spathian boundary: insights from zinc and carbon

LAISHI ZHAO[1], XIANGDONG WANG[1], ZHONG-QIANG CHEN[1], LEI ZHANG SR.[1], ZHENGYI LYU[1] AND FEIHONG YE[2]

[1]China University of Geosciences (Wuhan)
[2]China University of Geosciences
Presenting Author: zlscug@163.com

The biotic recovery following the end Permian mass extinction (EPME) was unstable with repeated environmental crises, each of which was followed by a comparably more hospitable interval for life. The early Triassic Smithian-Spathian boundary (SSB) event represents a conspicuous turnover in the environment, climate, and biotic communities. To explore the causes and consequences of this event we measured zinc and carbon isotopes along with elemental paleoenvironment proxies through the West Pingdingshan section, Chaohu, South China. An abrupt decrease of $\delta^{66}Zn$ values, along with the highly negative $\delta^{13}C$ values occur in the latest Smithian in Beds 47–50 of the section, are coincident with the bio-crisis, and are ascribed to weak marine productivity and extremely hot climatic conditions. Rapid positive shifts in $\delta^{13}C_{org}$ and $\delta^{13}C_{carb}$ values and high contents of TOC in Beds 51–52, demonstrate elevated marine productivity associated with a surface seawater cooling event, but also resulted in oxygen-starved conditions lethal to organisms. Marine and terrestrial ecosystems recovered in the early Spathian in Beds 53–57, as evidenced by high values of $\delta^{66}Zn$, $\delta^{13}C$ and the absence of framboid pyrite, and low Al content. These characteristics indicate a return to normal marine productivity and oxygenated seawater, and decreased terrestrial sediment input. Our findings propose that marine productivity played an important role in affecting the marine Zn cycling across the SSB and provide a scenario of environmental perturbations in response to temperature changes during the SSB transition.