Sulfate-controlled marine euxinia in semi-restricted inner Yangtze Sea during the Ordovician-Silurian transition

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The Late Ordovician has been recognized as a significant period in Earth's history during which global climate and oceanic environment experienced momentous changes and life suffered the second severest mass extinction of the Phanerozoic. Recent studies have suggested the existence of spatial-temporal heterogeneity in oceanic redox conditions during the Ordovician-Silurian transition (OST), which may have played a key role in the mass extinction event, however, details of the redox evolution and its mechanisms remain uncertain.

Our high-resolution chemostraigraphic study was conducted in a drillcore section (Pengye 1#) from Pengshui County, South China, which was located in the semi-restricted inner Yangtze Sea during the OST. We analyzed Fe-speciation, redox-sensitive trace elements (RSTEs), major elements, and pyrite $\delta^{34}S$ compositions and then compared these data with results from coeval sections at Datianba and Shuanghe in same basin. The integrated dataset demonstrates pronounced spatial and temporal heterogeneity of redox conditions in the inner Yangtze Sea, with dynamic control by regional sulfate concentrations. The inner Yangtze Sea was characterized by high primary productivity, which depleted dissolved sulfate concentrations through microbial sulfate reduction (MSR) except in areas with enhanced sulfate supply from riverine sources or open-ocean exchange. The spatially limited sulfate distribution in the stratified inner Yangtze Sea limited the development of euxinic conditions in specific areas, as reflected in regional variation in pyrite $\delta^{34}S$ values. The present study documents a mechanism for the marine redox evolution in the semi-restricted inner Yangtze Sea, which may have significant implications for the mass extinction during the OST.