Multiple sulfur-isotopic evidence for prolonged earliest Jurassic euxinia

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The Triassic-Jurassic (Tr-J) transition witnessed one of the 'Big Five' mass extinctions of the Phanerozoic. Significant perturbations of the carbon cycle have been found to accompany this biotic crisis, while less is known about its effects on the sulfur cycle. Here we present multiple sulfur isotope records ($\delta^{33}S$ and $\delta^{34}S$) of pyrite and weight ratios of pyrite sulfur to total organic carbon (S_{py}/TOC) in two Tr-J successions from the European epicontinental seaway (EES), providing insights on sulfur cycling and redox conditions in these shallow-marine sites. On the basis of $\Delta^{33}S$ and S_{py}/TOC data, the generally high pyrite $\delta^{34}S$ values in the latest Triassic can be attributed to sulfate limitation in sediment porewaters beneath an oxic/suboxic water column. A distinct negative shift in pyrite $\delta^{34}S$ occurred at the base of the Jurassic, above the main biotic crisis interval (Triletes Beds). The low $\delta^{34}S$ values coincided with a high concentration of green sulfur bacterial (GSB) biomarkers and high S_{py}/TOC ratios, suggesting a euxinic environment. Although the GSB biomarkers are generally below the detection limit in the overlying strata, our multiple sulfur isotopes and S_{py}/TOC data indicate that bottomwater euxinia lasted for ~2 million years (Myr). The temporal relation between the biotic crisis and redox changes suggest that water-column euxinia may not have been a proximate kill mechanism in shallow-water settings, although it likely affected the subsequent recovery of marine ecosystems.