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Barium isotope evidence for rapidly enhanced marine primary productivity triggering the end-Permian oceanic anoxia

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The end-Permian mass extinction (EPME) witnessed the most severe loss of marine and terrestrial biota in geological history and oceanic anoxia/euxinia has been a leading hypothesis to account for this event[1][2][3]. However, the drivers for the expansion of ocean anoxia across the EPME remain exclusive. While enhanced marine productivity has been invoked to explain the oceanic anoxia event, direct evidence for enhanced marine productivity is lacking. Here we present the paired analysis of barium isotopes ($\delta^{138}Ba$) and uranium isotopes ($\delta^{238}U$) of carbonate rocks spanning the Permian-Triassic transition to place constraints on the relative changes in marine productivity across the EPME event. We observed a large positive $\delta^{138}Ba$ shift towards the maximum of ~0.30‰ preceding the rapid expansion of oceanic anoxia characterized by a steep decrease of $\delta^{238}U$ from three peleogeographically widely separated sections. This observation suggests that enhanced marine primary productivity preceded the oceanic anoxia across the Extinction Horizon by at least 100 kyr. A perspective of seawater temperature-driven ocean deoxygenation has been exclude by a clear rising trend lagging behind the enhanced marine primary productivity. Hence, we propose that the strengthened remineralization of particulate organic matters can reasonably explain the expansion of ocean anoxia and/or euxinia across the EPME interval.

Reference

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