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A strong negative Cadmium isotope excursion marks the OAE2 in the Trans-Saharan Epicontinental Seaway: Implications for nutrient supply and productivity

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The Oceanic Anoxic Event 2 (OAE2) caused major perturbations in global carbon and nutrient cycles, characterised by enhanced productivity and organic matter burial under widespread marine anoxia. Cadmium (Cd) isotopes are a useful tool for tracking the nutrient utilisation by primary producers, yet there are few sedimentary records from shallow epicontinental seas. In this study, we report Cd isotope compositions and concentrations from the Ashaka section deposited in the Trans-Saharan Epicontinental Seaway (TIS) to investigate changes in productivity during OAE2 and their relationship to weathering-derived nutrient supply.

The Ashaka section comprises a 24-meter-thick succession of limestone and shale deposited during the Cenomanian-Turonian marine transgression into the TIS, which connected the proto-Atlantic and Tethys oceans. Elevated Chemical Index of Alteration and K/Al ratios indicate intensified continental weathering and enhanced nutrient delivery to the TIS. Authigenic Cd isotope compositions ($\delta^{114}Cd_{auth}$) values range from -1.19 to 0.15 ‰, with a pronounced negative anomaly during the OAE2. Relationships between Cd and total organic carbon (TOC) indicate that Cd is primarily associated with organic matter and that sulfide formation has a minimal influence.

Reconstructed Cd isotopic compositions of ambient fluid ($\delta^{114}Cd_{fluid}$) indicate near-quantitative removal of Cd and high productivity conditions before the OAE2. During the initial build-up and recovery stages of the OAE2, $\delta^{114}Cd_{fluid}$ approaches those of modern surface seawater, consistent with biological uptake and quantitative removal. In contrast, the trough and plateau phases are characterised by $\delta^{114}Cd_{fluid}$ values that are significantly lighter than the modern deep ocean, reflecting restricted circulation, enhanced light Cd supply from terrigenous sources, and enhanced organic matter burial within the epicontinental TIS. Our results highlight a global heterogeneity in Cd cycling during OAE2, demonstrating that shallow Epicontinental seaways played a critical role in modulating nutrient availability and productivity during anoxic events.