

Lacustrine expansion and carbon drawdown during the early Toarcian Oceanic Anoxic Event

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The early Toarcian Oceanic Anoxic Event (T-OAE; ~183 Ma) was marked by marine anoxia-euxinia and globally significant organic-matter burial, accompanied by a major global carbon cycle perturbation likely linked to Karoo-Ferrar volcanism. Although the T-OAE is well studied in the marine realm, accompanying climatic and environmental change on the continents is poorly understood. Here, Re-Os radiometric dating is applied to an Early Jurassic lacustrine system in China with a well-constrained isochron, suggesting the lacustrine Da'anzhai Member black shales to be Toarcian in age. Together with bio- and chemo-stratigraphy, we demonstrate that a major lake system developed on land coeval with the T-OAE, likely due to enhanced hydrological cycling under elevated atmospheric $p\text{CO}_2$. The more radiogenic initial $^{187}\text{Os}/^{188}\text{Os}$ value of ~1.29, significantly higher than Early Jurassic Toarcian marine $\text{Os}_{\text{initial}}$ values of 0.4–1.0 recorded from Europe, indicates high continental crustal input, which agrees with a lacustrine depositional environment. Increased lacustrine organic productivity from elevated riverine nutrients supply eventually led to the massive carbon burial in the Sichuan Basin at that time.