

Global redox and bio-productivity changes during the Oceanic Anoxic Event 2 (OAE2): new insights from combined U-C isotopes of the Trans-Saharan epicontinental seaway

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The Cenomanian-Turonian boundary (~ 94 Ma) marked a presumably global ocean anoxic event (OAE2), resulting in the widespread deposition of black shales, biotic turnover, and significant changes in global climate. While increased volcanic activity was suggested to have enhanced nutrient supply, increasing primary productivity and O₂ consumption could have triggered global anoxia. However, recent studies predict contradictory redox conditions from the open ocean to epicontinental seas. To better understand global redox variations, we review existing C-U isotopic compositions of marine OAE2-bearing sediments and add a previously overlooked locale, the Trans-Saharan Epicontinental Seaway. We investigated the first integrated geochemical dataset from the Ashaka quarry section, Nigeria, including $\delta^{13}\text{C}_{\text{org}}$ and $\delta^{238}\text{U}$, total organic carbon (TOC), and redox-sensitive and bio-essential trace metal concentrations of authigenic sediment phases. We propose the possible location of the OAE2 within this section and reconstruct local variations in the Trans-Saharan Epicontinental Seaway redox and bio-productivity and its linkage to global OAE2 signatures.

The chemo-stratigraphic beginning of the OAE2 in the Trans-Saharan Seaway is marked by a globally documented positive $\delta^{13}\text{C}_{\text{org}}$ excursion (-25.5 to -23.5 ‰). However, unlike many OAE2 sections with high total organic carbon (TOC: 5-30 wt. %), the Trans-Saharan Epicontinental Seaway records low TOC (0.3-1.2 wt.%), similar to the reported low TOC values in the Western Interior Seaway. These differences indicate poor regional organic matter preservation, as shown by increasing C/N ratios (4.4–10.3) and low HI/OI ratios, contrasting with organic matter preservation in the deeper N.-Atlantic Ocean. Micro-to-macronutrient ratios in the Trans-Saharan Seaway were low during the OAE2, suggesting suppressed productivity similar to that in the Western Interior Seaway and distinct from the high-productivity regimes in the Tarfaya Basin. Mo_{EF}/U_{EF} ratios indicate oxic conditions, similar to the Western Interior Seaway, however, different to the persistent anoxia in the Gubbio section and Demerara rise. Despite locally partly oxygenated conditions,

a negative $\delta^{238}\text{U}_{\text{sw}}$ shift in the Trans-Saharan Epicontinental Seaway mirrors records from the Demerara Rise, Eastbourne, Western Interior Seaway, and Morelos Formation. However, the magnitude of this shift varies globally across the OAE2 sections. In some OAE2 sections, such as Mangotane B, $\delta^{238}\text{U}_{\text{sw}}$ negative shifts are not recorded.