

Global vs. Local Effects- Carbon Isotopic Signatures During Toarcian Oceanic Anoxic Event (T-OAE)

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The Toarcian oceanic anoxic event (T-OAE, ~183 Ma) is marked by the occurrence of organic rich black shales with a negative carbon isotope excursion (CIE). This negative CIE has been interpreted as a global perturbation of the carbon cycle caused by the exhalation of the Karoo-Ferrar large igneous province and/or a release of methane at the onset of the T-OAE. However, several publications challenge the causal connection between T-OAE and the negative CIE to be a global event. In order to understand the connection between an abundance of organic rich shales and negative CIE during the T-OAE, molybdenum concentrations, TOC values, $\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{13}\text{C}_{\text{org}}$ were measured in organic rich shales and carbonates from a drill core in Dotternhausen deposited in the south-west German Basin on an epi-continental shelf during the T-OAE.

The low slope of the Mo/TOC ratios indicates an extensive restriction of deep water renewal and supply of open ocean molybdenum to the basin during T-OAE. Although $\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{13}\text{C}_{\text{org}}$ covary in the course of the CIE during the T-OAE a systematically isotopic decoupling between both carbon reservoirs, expressed as $\Delta^{13}\text{C}_{(\text{carb-org})}$, is observed. The $\Delta^{13}\text{C}_{(\text{carb-org})}$ decoupling is best explained by a carbon isotope mixing deposition model with a secondary methane input from the upper sediment layer in a restricted marine basin. Methane acts as a source of isotopically light dissolved inorganic carbon source from which authigenic carbonates and organic matter have formed and could explain the isotopic decoupling between $\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{13}\text{C}_{\text{org}}$ on a local scale. The isotope mixing model does not negate the global release of isotopically light carbon into the Earth's atmos- and hydrosphere but might explain differences in extent of the CIE in other localities during the T-OAE.