Controls on biomarker and carbon isotope patterns during the Toarcian anoxic event (Dormettingen section; Swabian Alb)

Ajuaba, Stephen[1]; Sachsenhofer, Reinhard F.[1]; Bechtel, Achim[1]; Galasso, Francesca[2]; Groß, Doris[1]; Misch, David[1]; Schneebeli-Hermann, Elke[2]

1 Chair of Petroleum Geology, Montanuniversität Leoben, Peter-Tunner-Straße 5, A-8700 Leoben, Austria; 2 Paleontological Institute and Museum, University of Zürich, Karl-Schmid-Straße 4, CH-8006 Zürich, Switzerland.

The Toarcian oceanic anoxic event (T-OAE) is associated with a prominent negative carbon isotope excursion (CIE; ~183 million years). About 10-m-thick organic matter-rich sediments accumulated during the T-OAE in the Southwest German Basin (SWGB). Rock–Eval, maceral and biomarker analysis were used to determine variations of environmental conditions across the CIE interval. Carbon isotope records were determined for various n-alkanes, pristane and phytane to contribute to the reconstruction of the paleo-environment and to study the factors controlling molecular $\delta^{13}C$ values. Geochemical redox indicators provide evidence for photic zone anoxia during the Toarcian CIE, which reached its maximum after deposition of the “Unterer Stein” marker horizon. The 2α-methylhopane index suggests enhanced activity of diazotrophic cyanobacteria, which is also supported by nitrogen isotope data. This distinguishes the SWGB from other Toarcian basins with black shale deposition. Oxygen-depleted conditions, albeit with lower intensity continued after the CIE. All investigated organic compounds replicate the negative CIE, but the magnitudes vary considerably. The largest shift is observed for n-C27 (9 ‰) and reflects the combined effect of the global CIE and a major change in organic matter input (termination of terrigenous organic matter input). The shift for short-chain n-alkanes, pristane, and phytane, interpreted to reflect marine biomass, varies between 4.5 and 5.0 ‰. This is the highest value observed so far for any Toarcian section. $\delta^{13}C$ values of pristane and phytane reach a minimum near the base of the CIE interval and increase upsection. Thus, the maximum negative isotope shift predates the strongest basin restriction by about 450 thousand years.