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The Cenomanian/Turonian transition in the tropics: a dual-proxy sea surface temperature record from the Demerara Rise (ODP Leg 207)

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The mid-Cretaceous represents a time in Earth history characterized by extreme global warmth. Records of paleo-sea surface temperatures (SSTs) from the mid-Cretaceous oceans are considered to be important for the understanding of greenhouse climate conditions and related processes of climate change. The peak-temperatures of the Cretaceous "greenhouse" were reached shortly after the Cenomanian/Turonian (C/T) Oceanic Anoxic Event (OAE-2). In comparison to other Cretaceous OAEs, OAE-2 is prominent with regard to the quantity of organic carbon (OC) deposited in black shales in different marine settings world wide. OAE-2 is marked by a strong biotic crisis and a globally observed positive carbon-isotope excursion that is thought to be caused by the massive perturbation of the carbon-cycle linked to the OC-burial spanning the C/T-boundary interval (CTBI).

Here we present a detailed tropical SST-record across the C/T-transition from Ocean Drilling Project (ODP) Leg 207 Site 1260 by employing the TetraEther indeX of 86 carbon atoms (TEX_{86}), a novel organic SST-proxy, in combination with stable oxygen isotope paleothermometry on planktic foraminifera. Leg 207 recovered 30-95 m thick intervals of mid-Albian to Santonian organic matter rich black shales from sites 1257-1261 located on the north-western tip of the Demerara Rise, a submarine plateau off-shore Suriname and French Guyana (western equatorial Atlantic). We investigated 20 m of partially highly carbonaceous C/T-black shales at Site 1260.

The CTBI is evident from a positive $\delta^{13}C_{org}$-excursion with a 6.6 permil magnitude and an increase in the average total organic carbon content (8-11%). Because age-indicative fossils are widely absent within this interval, the stratigraphic range of the CTBI is defined here by the isotopic excursion. Excellently well preserved specimens of the foraminiferan species *Hedbergella delrioensis* and *Heterohelix moremani* were used to reconstruct Cenomanian to Turonian SSTs. Deteriorated preservation of the carbonate phase and paucity of planktic foraminifera precluded oxygen isotope-paleothermometry throughout the CTBI itself. Thus, here but also in stratigraphically adjacent intervals, we employed the TEX_{86} SST-proxy.

On a long-term perspective, the dual-proxy SST-record from Site 1260 shows that the CTBI falls into a broad thermal maximum near 35-36˚C. This observation is consistent with paleotemperature-records from other regions located outside the tropics, corroborating that the C/T-transition represents the warmest Cretaceous time-interval. In agreement with studies arguing for warm and not cold mid-Cretaceous tropics, reconstructed SSTs were permanently exceeding 30˚C during this interval at Site 1260. Generally, a good match of TEX_{86}-SSTs with $\delta^{18}O$-paleothermometry is observed. Our high resolution TEX_{86} SST-record through the CTBI shows that the onset of the event coincided with a rapid rise by $\sim$2-3˚C in tropical SSTs, which were already much warmer than today ($\geq$33˚C). The initial warming is followed by a strong SST-decline by $\sim$4˚C to even lower than pre-OAE temperatures likely caused by the excessive carbon burial. Then, SSTs stepwise rise to 35-36˚C again and persist into the early Turonian. These findings give new insights into trigger- and feedback processes of OAEs and to those related to climate changes under greenhouse conditions.