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Terrestrial input into the upper Cretaceous western tropical Atlantic as traced by biomarker and maceral analyses

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The mid Cretaceous represents one of the most prominent episodes of greenhouse climate with high atmospheric CO2 levels and much higher global temperatures than today. During this super-greenhouse, massive and widespread deposition of organic carbon occurred during several Oceanic Anoxic Events (OAEs). The OAEs are associated with prominent shifts in carbon isotopes and thus represent major disturbances of the ocean system and the global carbon cycle. As such, OAEs played a fundamental role in the evolution of Earth's climatic and biotic history. In the past, research on the dynamics of the mid Cretaceous greenhouse world was almost exclusively based on marine proxy data, while up to now, only few information is available on environmental dynamics and atmosphere/biosphere interactions in terrestrial settings.

We investigate two sites (1258 and 1260), drilled approx. 350 km off Suriname at the Demerara Rise during ODP Leg 207, recovering late Albian to Santonian sediments. These black shales were deposited in a proximal position relative to the tropical South American mainland and provide the unique opportunity to link terrestrial environmental information with a wide range of marine paleoclimatic and paleoceanographic proxy data, thus allowing a direct land/sea correlation. Here, we show first results from our multi-parameter study along a stratigraphic splice from the mid Cenomanian to early Turonian, covering two exceptional paleoceanographic events, the OAE2 and the Mid Cenomanian Event (MCE). Our working strategy combines XRF-core scanning with microscopic investigation (maceral analysis), biomarker analysis and subsequently determination of isotopic composition of specific terrestrial organic compounds.

Samples from the investigated interval cover a large range of total organic carbon (TOC) concentration, the organic material proves to be thermally immature. For the OAE2, values vary between 1.4 % TOC after the maximum isotope excursion and 23.3 % TOC within the maximum excursion. Samples from the MCE are characterized by generally lower organic carbon variability with values fluctuating between 6% - 15 % TOC during the maximum isotope shift. First biomarker observations allow the identification of samples showing an almost exclusive marine distribution pattern of molecular markers as well as samples with a considerate input of terrestrial matter into the sediment. The latter are particularly suited for our anticipated molecular-isotopic approach to investigate carbon and hydrogen isotopes signatures of plant wax lipids to address changes in runoff variations and changes in the hydrological cycle. Initial molecular data show that long-chained n-alkanes from leaf waxes are present at levels varying between approx. 0.15 – 1.5 μg/g sediment. We currently measure carbon and hydrogen isotopes and will compare the resulting isotope ratios with first counting data from maceral analysis. This combination of microscopic and isotopic information, will give insight into the direct coupling between ocean, atmosphere, and terrestrial biosphere in the mid Cretaceous super-greenhouse.