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High resolution cyclostratigraphy of the early Eocene – new insights into the origin of the Cenozoic cooling trend

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Abstract. Here we present a high-resolution cyclostratigraphy based on X-ray fluorescence (XRF) core scanning data from a new record retrieved from the tropical western Atlantic (Demerara Rise, ODP Leg 207, Site 1258). The Eocene sediments from ODP Site 1258 cover magnetochrons C20 to C24 and show well developed cycles. This record includes the missing interval for reevaluating the early Eocene part of the Geomagnetic Polarity Time Scale (GPTS), also providing key aspects for reconstructing high-resolution climate variability during the Early Eocene Climatic Optimum (EECO). Detailed spectral analysis demonstrates that early Eocene sedimentary cycles are characterized by precession frequencies modulated by short (100 kyr) and long (405 kyr) eccentricity with a generally minor obliquity component. Counting of both the precession and eccentricity cycles results in revised estimates for the duration of magnetochrons C21r through C24n. Our cyclostratigraphic framework also corroborates that the geochronology of the Eocene Green River Formation (Wyoming, USA) is still questionable mainly due to the uncertain correlation of the "Sixth tuff" to the GPTS.

Right at the onset of the long-term Cenozoic cooling trend the dominant eccentricity-modulated precession cycles of ODP Site 1258 are interrupted by strong obliquity cycles for a period of ~800 kyr in the middle of magnetochron C22r. These distinct obliquity cycles at this low latitude site point to (1) a high-latitude driving mechanism on global climate variability from 50.1 to 49.4 Ma, and (2) seem to coincide with a significant drop in atmospheric CO_2 concentration below a critical threshold between 2- and 3-times the pre-industrial level (PAL). The here newly identified orbital configuration of low eccentricity in combination with high obliquity amplitudes during this ~800-kyr period and the crossing of a critical pCO_2 threshold may have led to the formation of the first ephemeral ice sheet on Antarctica as early as ~50 Ma ago.

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