Climate and carbon cycle dynamics during late Paleocene - early Eocene transient global warming events

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Superimposed on a long-term Late Paleocene – Early Eocene warming trend, several phases of transient global warming occurred, called 'hyperthermals'. These include the well-studied The Paleocene-Eocene thermal maximum (PETM; ~55.5 Ma). Hyperthermals are associated with massive injection of 13C-depleted carbon into the ocean-atmosphere system that marked the events with a negative carbon isotope excursion (CIE) in sedimentary components. Documentation of hyperthermal Eocene Thermal Maximum 2 (ETM2, ~53.5 Ma) is limited, hampering evaluation of its global nature and pattern of change as well as comparison to the PETM. We present data from the ETM2 section recovered from the Lomonosov Ridge, Arctic 13C of total organic carbon (TOC) shows aδOcean (IODP Expedition 302). The ~3.5‰ negative CIE at the onset of ETM2. Dinocyst assemblages show a freshening and eutrophication of Arctic Ocean surface waters. TEX86-derived SSTs show a ~3-4 °C rise. Maximum atmospheric temperatures of ~23°C are consistent with pollen of palm trees, implying coldest month minimum temperatures >8°C. Laminated sediments and the absence of organic foraminiferal linings suggest that anoxia persisted at the sediment-water interface. Biomarker analyses also indicate euxinic conditions in the photic zone during ETM2. All trends, including those recorded using XRF core scanning techniques, mimic those recorded for the PETM but generally exhibit a slightly smaller magnitude. Our findings corroborate the notion that ETM2 was indeed a true global warming phase, associated with the rapid injection of light carbon. Moreover, TEX86 and palm tree pollen suggest that maximum ETM2 temperatures in the Arctic may have been warmer than those during the PETM.