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The Paleocene – Eocene Thermal Maximum in the Gulf of Mexico

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The Paleocene - Eocene Thermal Maximum (PETM) was a ∼170 kyr long period of extreme warming, superimposed on already warm Early Paleogene conditions. The PETM is associated with a ∼3.5‰ negative carbon isotope excursion (CIE) in sedimentary components that marks a massive injection of 13C-depleted carbon into the ocean-atmosphere system. Biotic response included the poleward expansion and global dominance of the subtropical dinoflagellate cyst (dinocyst) Apectodinium., but low latitude date remain sparse. We found the PETM in a sediment core called Harrell, in Mississippi, USA, from the northern margin of the Gulf of Mexico at ∼30 °N. Sediments are poor in biogenic carbonate, but contain organic matter, partly comprised of rich palynomorph assemblages (notably dinocysts and pollen) and biomarkers, suitable for paleoenvironmental analyses.
We found a -3‰ CIE in bulk organic carbon in sediments calibrated to nannofossil zone NP9. This interval is also marked by dominant Apectodinium dinocysts, together diagnostic of the PETM. Two independent biomarker-based paleotemperature proxies indicate substantial PETM warming: mean annual sea surface temperature, based on TEX86, and mean annual air temperature, based on MBT, increased by ∼6-7 °C. Absolute temperature reconstructions for the Paleocene are consistent with previous paleovegetation-based estimates. Moreover, peak PETM temperatures are similar to those recorded in New Jersey, suggesting a small temperature gradient between these two regions. High relative abundances of terrestrially-derived palynomorphs and biomarkers indicate a very shallow marine environment prior to the CIE, with significant river inflow. During the PETM, dinocysts are abundant and diverse indicating a more outer neritic shelf setting, consistent with sea level rise during the PETM.