Temperature-dependent calcareous nannofossil export productivity during early Paleogene hyperthermals

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https://doi.org/10.58998/jnr3267

Oceanic carbonate burial is the main carbon sink on a geological timescale. Deep-sea records of early Paleogene hyperthermals, which are abrupt greenhouse warming events associated with rhythmic massive releases of carbon into the ocean–atmosphere system, show drastic changes in calcite burial. Such lithologic perturbations have largely been attributed to chemically induced modulation of deep seafloor calcite preservation.

Here, we use microfossil (nannofossil abundances and planktonic foraminiferal fragmentation) and geochemical evidence (extraterrestrial ^{3}He) to reconstruct calcareous nannofossil fluxes across ~10 hyperthermals (~57.5–53.5 million years ago) for a North Pacific deep-sea site located above the lysocline. We also calculated the nannofossil fluxes during the Paleocene–Eocene Thermal Maximum (PETM) at South Atlantic and Southern Ocean sites, using previously published ^{3}He data, to obtain a global picture of the biotic response of planktonic calcifiers in the open ocean. Overall, we found a partial decoupling between seafloor saturation and calcareous nannofossil export production. Repeated 40–99% decreases in nannofossil burial across hyperthermals were primarily driven by warming-induced lowering of nannoplankton-derived calcite export productivity, and secondarily by changing bottom water chemistry. Our results emphasize that shallow-water (<1000 m) ecosystems and metabolic processes are overlooked as chief mechanisms for regulating carbon cycle feedbacks on a geological timescale.