

Multi-elemental data structure of the Indian Ocean deep-sea sediments recording the early Eocene hyperthermals

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Multiple transient global warming events occurred during the early Paleogene. The most prominent of these events was the Paleocene-Eocene thermal maximum (PETM) at ~56 Ma, which is characterized by a rapid and extreme global warming by 5-8°C, severe ocean acidification, and a distinct negative carbon isotope excursion in the marine and terrestrial realm. In addition, several PETM-like global warming episodes called 'hyperthermals' during the early Eocene period (56-52 Ma), accompanying rapid and pronounced negative excursions in the carbon isotopic composition ($\delta^{13}\text{C}$), have also been recognized worldwide recently.

Here we have constructed a comprehensive geochemical data set including major- and trace-element contents, $\delta^{13}\text{C}$, and CaCO_3 contents of 250 bulk sediment samples taken from ODP Sites 738 and 752, both located in the Indian Ocean. The analytical results show that the sediments of these cores record multiple carbon isotope excursions and reductions of carbonate contents, probably corresponding to the PETM and some of the early Eocene hyperthermals. We apply Independent Component Analysis to the compositional data matrix, and describe the fundamental structure of the multi-elemental data set on the basis of the extracted geochemical independent components.

Keywords: deep-sea sediment, Indian Ocean, climate change, hyperthermals, Independent Component Analysis