Effects of Size-Selective Sediment Mixing on the Carbon Isotope Record of the Paleocene-Eocene Thermal Maximum

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ABSTRACT

It is well established that sediment-mixing processes distort stable isotope stratigraphies used for global correlation. The Paleocene/Eocene boundary is marked by a sharp decrease in the carbon isotopic composition of marine carbonates, but the stratigraphic position assigned to the initial onset of this isotopic excursion varies with sediment grain size. For example, the shift to lower isotopic values in fine-fraction carbonate can occur ~10-15 cm above where it is registered in coarse-fraction foraminiferal records for the same sediment core. This discrepancy is clearly an artifact of size-selective sediment mixing. Yet this complicating factor is often overlooked by studies using size-dependent trends in the stable isotopic signatures of planktonic foraminifera to infer past changes in the ecology. Specifically, an apparent loss of size-dependent stable isotopic signatures among fossil planktonic foraminifera across the aforementioned isotope excursion has been cited as evidence for "symbiont bleaching". Here, I argue that the loss of this size-dependent signal is due to size-selective sediment mixing whereby smaller shells with higher (pre-excursion) carbon isotope ratios have been preferentially reworked up-section across the isotope excursion. To test my hypothesis, stable isotope measurements will be carried out on planktonic foraminiferal shells taken from a graduated series of size-segregated samples straddling the isotope excursion. I predict that the onset of the isotope excursion will appear in sequential order, with it first appearing in the coarser size fractions. Such a stratigraphic succession will dispel speculation regarding symbiont bleaching and underscore how sediment mixing alters stable isotope records compiled from deep-sea sediments.

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