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Organic carbon cycling in deep-sea benthic ecosystem during the Paleocene-Eocene Thermal Maximum

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The Paleocene-Eocene Thermal Maximum (PETM) has been held up as a past analog to future warm environments and presents the opportunity to study climate impacts on marine communities. Today the deep-sea benthic ecosystem contributes substantially to carbon cycling in seafloor sediments. During the PETM, amount of carbon would have input into ocean and biosphere. The carbon could be taken up by organisms with higher metabolic rate under warm condition. However, the role of metabolic rates in benthic organisms has never been elucidated. Metabolic rates reflect respiration, that exchanges carbon between organic matter and carbon dioxide, thus respiration reflects both carbon cycling as well as metabolic rates in an organism. Here we evaluate respiration of ostracodes from DSDP Site 401, outer Bay of Biscay, North Atlantic through the onset of the PETM. Ostracode respiration can be calculated using body size and temperature. We measured ostracode body size and analyzed benthic foraminifer Mg/Ca thermometer. Body sizes of three species decreased through the onset of the PETM, while temperature of the bottom water increased. Estimates of the body size and temperature suggest a decline in lifetime respiration in ostracode individuals during the PETM interval. The reduced respiration might be related to decreases in metabolic rates and oxidation of organic matters. Dwarfed ostracodes during the PETM core interval would uptake less organic matters than ostracodes in the pre-PETM interval, since ecological studies show that modern ostracode grazing rates depend on their body-sizes. Hence we consider major changes in the energy and carbon balance of the benthic food-chains and the reduction of organic carbon flux between the ostracodes and sediments during the PETM. The decline in ostracode carbon flux contrasts with previous interpretations that benthic foraminifers switched their taxonomic composition that recycled more organic matters.

Keywords: DSDP Site 401, Ostracoda, Body size, Metabolic rate, Paleocene-Eocene Thermal Maximum, Organic carbon cycling