Constraints on volcanic and thermogenic carbon emissions during the Paleocene-Eocene Thermal Maximum

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Processes associated with the North Atlantic Igneous Province (NAIP) and surface carbon cycle feedbacks interacted to shape the Paleocene-Eocene Thermal Maximum (PETM, 56 million years ago). An enigmatic 100-kyr plateau or 'body phase' distinguishes the PETM carbon isotope excursion (CIE) from other Paleogene hyperthermal events and could signal long-term net-positive carbon cycle feedbacks, such as shale weathering or deep hydrates, unique to the most severe carbon cycle perturbations. To resolve whether such feedbacks are required to explain a long-lasting carbon-cycle perturbation, we generate a sedimentary mercury-based estimate of concurrent volcanic contributions, from both extrusive and intrusive igneous activity in sedimentary basins along the Northeast Atlantic margins. Samples obtained during International Ocean Discovery Program Expedition 396 from within a hydrothermal vent complex were analyzed for sedimentary mercury. Spatial patterns in Hg and Os isotope data during the PETM CIE show elevated volcanic fluxes and intense hydrothermal activity after sill intrusions. Using our Hg data and Hg:C ratios of modern systems, we estimate >4,000 petagrams of ^{13}C-depleted carbon (< -25‰) may have been released from combined NAIP-sources during the CIE body. This may have offset the observed enhanced organic carbon burial and other negative carbon cycle feedbacks, and reduces the need for major long-term positive feedbacks.