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A High-Resolution Record from Svalbard of Carbon Release during the Paleocene–Eocene Thermal Maximum

Ying Cui*, **Lee R Kump**
Department of Geosciences and Earth System Science Center, Pennsylvania State University, University Park, PA 16802, *USA*
Andy Ridgwell
*School of Geographical Sciences, University of Bristol, University Road, Bristol BS*8 1*SS, UK*
Aaron Diefendorf, **Chris K Junium**
Department of Geosciences, Pennsylvania State University, University Park, PA 16802, *USA*

Newly analyzed core material from Svalbard presents a highly expanded clastic sedimentary section spanning the Paleocene–Eocene thermal maximum (PETM). Carbon isotopic analysis of the bulk organic matter extracted from core BH9-05 details the onset of the negative carbon isotope excursion of approximately 4.5‰ over 5 m of section (sampled every 30 cm). The entire excursion is 50 m in thickness, and is nearly identical in shape to the recently published orbitally tuned record from ODP Site 1263, allowing us to establish a tentative chronology for the core. Using this record to drive an intermediate complexity earth-system model (Genie-1; http://www.genie.ac.uk), we determine the implied rates of carbon release at the Paleocene–Eocene boundary necessary to replicate the isotope excursion and assuming different alternative isotopic compositions for the possible sources of fossil carbon driving the excursion (methane clathrate, coal/peat/marine organic matter). We find that the peak rate of carbon addition is only a small fraction of the current rate of fossil fuel burning whether the source is methane or organic matter. Model/data comparison, especially the observed and modeled seafloor carbonate dissolution record, favors the smaller (ca. 2 000 Pg C) cumulative addition associated with a ^{13}C depleted source (methane). Model sensitivity analysis shows that while the rate and amount of carbon added (for a specified source type) is relatively insensitive to key model uncertainties, the predicted seafloor carbonate dissolution response is quite sensitive to the source type and the presumed initial conditions (ocean alkalinity and initial sedimentary carbonate contents, which affect the ocean's buffering capacity).

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*Corresponding author: yzc122@psu.edu

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