American Geophysical Union Fall Meeting, San Francisco, CA, Dec 12-16, 2016, *invited*

Atmospheric carbon dioxide persisted at near modern levels before and after the PETM

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The Paleocene-Eocene Thermal Maximum (PETM) has been proposed as a modern analog to present-day global warming. However, proxy data for the concentration of carbon dioxide in the atmosphere (pCO_2) across the event are poorly constrained. Here we use existing carbon isotope data and the increase in carbon isotope fractionation by C_3 land plants in response to increased pCO_2 to provide estimates of pCO_2 before, during, and after the event. Using multiple combinations of marine benthic foraminifera with terrestrial organic matter and paleosol carbonate, and two different potential sources (methane hydrate and permafrost-thawing/organic matter oxidation), we determined that background pCO_2 was similar to modern levels. Specifically, provided a methane hydrate source, our calculations suggest pre-PETM and post-PETM pCO_2 of only 265 +162/-80 and 321 +78/-10, respectively; the permafrost-thawing/organic matter oxidation scenario requires notably higher background pCO_2 of 433 +217/-127 ppmv (pre-PETM) and 551 +115/-163 ppmv (post-PETM). These results suggest that regardless of the source, pCO_2 returned to near pre-event levels, following a calculated ~2 to 4× increase in pCO_2 during the event. Although neither scenario can be ruled out, the higher background pCO_2 (similar to the broad range of estimates predicted for the 21st century) required for the permafrost-thawing/organic matter oxidation scenario is more consistent with the greenhouse climate of the early Paleogene.