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Exploring links between the North Atlantic Igneous Province and Paleocene–Eocene climate change using sedimentary mercury

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The North Atlantic Igneous Province (NAIP), a large igneous province (LIP), was emplaced between ~62 and 50 million years ago (Ma), with a voluminous burst of volcanic activity centred around 56-54 Ma. Global paleoclimate reconstructions from this Paleocene and Early Eocene interval indicate progressively warmer conditions, with several superimposed warming events or 'hyperthermals', such as the Paleocene–Eocene Thermal Maximum (PETM; 56 Ma). These hyperthermals represent transient massive perturbations to the carbon cycle, marked by substantial global warming, ocean acidification and negative stable carbon isotope excursions. International Ocean Discovery Program Expedition 396 to the Mid-Norwegian continental margin recovered a suite of Paleocene–Eocene sedimentary and igneous materials. This notably includes a unique and extremely expanded succession comprising of up to ~80m of PETM (ash-rich) sediments and volcanic ash layers infilling a hydrothermal vent crater. The craters on the Mid-Norwegian margin and similar structures associated with other LIPs were previously identified as surface expressions of a potent carbon release mechanism: the venting of thermogenic carbon generated in the thermal aureoles around volcanic dikes and sills intruded into the underlying sedimentary basins.

In recent years, much progress has been made towards understanding the role of deep earth processes and particularly LIP volcanism on paleoclimate through the application and refinement of proxies as sedimentary mercury (Hg) content. Large scale and especially LIP volcanism are considered important Hg emitters that may result in increased sedimentary Hg content. Here, we present high-resolution bulk sedimentary Hg content data from the sedimentary strata within the hydrothermal crater, spanning the PETM. We use our new data with biostratigraphic, stable carbon isotope, and lithological constraints, to shed light on the timing of hydrothermal crater formation, duration and re-activation of hydrothermal activity within the crater after formation. Finally, these new findings are placed in a global Hg and carbon cycle framework to assess the timing, characteristics, and impact of NAIP activity during the PETM.

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