Geophysical Research Abstracts
Vol. 20, EGU2018-12321-1, 2018
EGU General Assembly 2018

Investigating mercury as a large igneous province proxy: Insights from the Palaeocene-Eocene Thermal Maximum

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Mercury (Hg) deposition in sedimentary systems is increasingly being used as a proxy for regional volcanism in the geological record. Eruptions are the dominant current source of Hg to the atmosphere, thus pulses in sedimentary Hg concentrations that are expressed as changes in the ratio of Hg/TOC (total organic carbon) likely reflect an increase in volcanic activity at the time of deposition. Numerous studies have sought to assess the relative importance of large igneous province (LIP) emplacements as a driver of rapid climate change and/or mass extinction events, and recent findings have shown Hg/TOC anomalies associated with several key events including the end-Permian and Cretaceous-Palaeogene extinctions. However, there may be other factors that could perturb the global Hg cycle, including contact metamorphism and bolide impacts. It remains unclear how the proximity to the source(s) of Hg affects the resulting Hg/TOC in the rock record. It is therefore imperative to investigate multiple sections for one event to fully understand the nature and extent of volcanism at that time. Here we focus on the Palaeocene-Eocene Thermal Maximum (PETM), an extreme (5-7 °C) and rapid (<20 kyr) global warming event that began around ∼55.8 Ma. The PETM coincided with a major pulse of magmatic activity from the North Atlantic Igneous Province (NAIP), which suggests that the emplacement of igneous material could have contributed to the climate perturbations. We focus on shallow marine sections located around the NAIP during the Palaeogene. The results indicate that there is considerable variation in the Hg/TOC signals between sites, perhaps reflecting differences in lithology and/or source proximity. However, there are clear pulses of Hg around the onset and recovery of the PETM in the sites proximal to the NAIP, suggesting that volcanic activity at least contributed to the observed climatic disturbances.