Deciphering the nature of subaerial/submarine Hg emissions associated with the North Atlantic Igneous Province during the Paleocene–Eocene Thermal Maximum

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Abstract

The Paleocene–Eocene Thermal Maximum (PETM) was a period of extreme warmth (˜56 million years ago) that lasted for ˜200,000 years and that had a profound influence on the global climate and ecosystems. The mean annual global temperature rose by 5–6 C over a few thousand years at the onset of the PETM, resulting from massive carbon release into the ocean and atmosphere. The emplacement of the North Atlantic Igneous Province (NAIP), both in the form of voluminous extrusive basaltic successions and magma intrusions into sedimentary basins, was most active around the Paleocene–Eocene transition, suggesting that volatile degassing from volcanic and thermogenic causes may have contributed to global warming.

A transect of five holes at IODP Sites U1567 and U1568 that sample the upper part of the Modgunn hydrothermal vent complex on the mid-Norwegian Margin were recently drilled during the International Ocean Discovery Program (IODP) Expedition 396. Stable carbon isotope stratigraphy and dinoflagellate cyst biostratigraphy confirm a PETM age for the vent infill. The aim of this study is to disentangle the relative contributions of subaerial and submarine emissions associated with basalt emplacement and sill intrusions into organic rich sediments during the PETM, which has implications on the causes of the carbon cycle perturbations over this hyperthermal event.

Variations in the concentration of Hg in organic carbon-rich sediments is widely used as a direct means of elucidating regional to global scale volcanic activity such as that associated with the NAIP, as well as earlier large igneous provinces. The PETM interval from the Modgunn site yields exceptionally abundant macrofossil wood (sub-centimetre to a few centimetres in diameter). The unconsolidated sediments allowed us to isolate fossil wood from

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more than 100 samples over the PETM interval from three of the boreholes. This study will discuss new data on the variations of Hg concentrations in fossilized woody materials, as well as bulk Hg concentration normalised to TOC of the bulk sediments from the same stratigraphic levels. We use these paired data to disentangle the Hg input from global atmospheric Hg-loading (subaerial volcanic in origin) and local submarine vent sources (volcanic or metamorphic).

Keywords: Paleocene–Eocene Thermal Maximum, Mercury concentration, North Atlantic Igneous Province, Hydrothermal vent complex