The chemostratigraphy of the Paleocene–Eocene infill of the Modgunn hydrothermal vent complex on the Norwegian continental margin

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Abstract

The Modgunn hydrothermal vent complex (HTVC) is one of hundreds of explosion craters that pepper the Vøring and Møre basins on the Norwegian continental margin. These HTVCs are rooted in shallow sill intrusions from the North Atlantic Igneous Province (NAIP) and are evidence of the explosive release of volatiles created by both contact metamorphism of country rock and the degassing of magma. Many of these craters appear to terminate close to the Paleocene–Eocene boundary in seismic sections, which led to the hypothesis that thermogenic degassing may have instigated and/or prolonged the Paleocene–Eocene Thermal Maximum (PETM) at ~56 Ma (Svensen et al. 2004). The International Ocean Discovery Program (IODP) Expedition 396 visited the Norwegian continental margin in 2021 to drill key NAIP localities. The Modgunn HTVC is on the edge of the Vøring Plateau with very little sedimentary cover, allowing for multiple holes to be drilled in a transect across the vent (Sites U1567-U1568). Initial isotopic and biostratigraphic findings placed the vent infill to just before and during the PETM, corroborating the hypothesis of a link between thermogenic degassing and the intense global warming (Berndt et al. 2023). The Modgunn locality is a perfect locality for geochemical studies across the Paleocene–Eocene boundary, as the rapid infill of the vent crater allows for high-resolution study of sediments in close proximity to NAIP activity.

Here we present a detailed chemostratigraphy of the Modgunn vent infill, expanding on the existing data set to identify the onset of the PETM in four of the five holes. Geochemical analyses of volcanic ash layers suggests several distinct populations from proximal to distal source within the NAIP. The occurrence of glendonite crystals in the Modgunn vent infill strata, a pseudomorph of the mineral ikaite, suggests cold bottom waters in the Nordic Seas, suggesting extremely stratified conditions in these restricted seas. Exotic pore water chemistries within the vent infill indicate that ikaite formation may have been promoted by volcanic ash-rich strata. Magmatic proxies such as mercury (Hg) contents indicate that vent activity in very close proximity to the Modgunn HTVC continued during the PETM, further linking the emplacement of the NAIP to the hyperthermal conditions.

References

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