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Constraining North Atlantic Igneous Province (NAIP) activity during the late Paleocene and early Eocene

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The close temporal correlation between the emplacement of large igneous provinces and environmental crises in the geological record suggests a causal relationship. One such example is the emplacement of the North Atlantic Igneous Province (NAIP) and the Paleocene-Eocene Thermal Maximum (PETM), an extreme climate change event that occurred ~56 Ma. The main pulse of activity from the NAIP is around this time, but current radioisotopic ages are too low-resolution to constrain whether this activity was before, during and/or after the PETM. An ideal locality for understanding the initiation and development of the PETM is the island of Fur, northwest Denmark. The sedimentary sequence consists of clays and diatomites deposited in an epicontinental, shallow marine sea. The high sedimentation rates and close proximity to the NAIP means there are numerous volcanic and climatic proxies in the strata that can be used to provide high-resolution records constraining the relative and absolute timings of these events.

Here we present the findings of the project 'Ashlantic', which focuses on pre- to post-PETM strata. We adopt a multiproxy approach using volcanic tracers, including tephra horizons, Hg anomalies, and Os isotopes, to infer the intensity and timing of NAIP activity. Volcanic glass morphology and chemistry suggests a hydromagmatic origin for key tephra intervals, while U-Pb dating of magmatic zircon constrains the timing of NAIP activity and the development of the PETM. Detailed chemostratigraphic logs and datasets (e.g. $\delta^{13}C$ analyses) define the onset and duration of the PETM, while clay chemistry, Li isotopes, total organic carbon (TOC), and the paleothermometer TEX_{86} are used to assess the climate response to global warming during the PETM. In concert, our results suggest that the NAIP was active just before, during, and after the PETM, but the relationship between the NAIP and the marine and terrestrial environments is complex. These findings call for further work, such as ICDP and/or IODP drilling of North Sea sediments.