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Linking warming, environmental changes, and volcanic ash falls from onset to recovery of the PETM: new insights from the island of Fur, Denmark

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The early Cenozoic is an interval characterized by a globally warm climate, punctuated by several even warmer hyperthermal events. The Paleocene-Eocene Thermal Maximum (PETM) is the most pronounced of these events, lasting ∼170 000 kyr from about 55.8 Ma, and causing a global temperature increase of ∼5-8 °C. The PETM was initiated by substantial release of δ13C-depleted carbon to the ocean-atmosphere system, causing a prominent negative carbon isotope excursion (CIE) between -2 and -7‰ in marine and terrestrial sediments. This global warming event coincided with the emplacement of the North Atlantic Igneous Province (NAIP), a volcanic event characterized by emplacement of massive lava flows and major sills and a few central vent volcanoes with a wide compositional range penetrating the carbon-rich sedimentary strata in the North Atlantic. One of the best marine exposures preserving the PETM interval is found on the island of Fur in northwest Denmark. Here, a ∼60 m thick sedimentary succession, comprising the Fur Formation diatomite clay, the underlying Stolleklint Clay, and more than 180 interbedded tephra layers of NAIP origin, covers the onset, duration and recovery phase of the PETM. During the summer of 2017, the Ashlantic Project drilled a ∼73.5m long core through the Fur Fm and down into the Stolleklint Clay, in order to investigate the role of volcanism in the prolonged global warming and observed climatic changes during the PETM. Here we present new geochemical data from high-resolution XRF-core logging, together with hyperspectral imaging of chlorophyll and its diagenetic products from both the new core and field samples. We also present new ocean temperature data from proxies such as TEX86, a temperature proxy based on the relative distribution of archael glycerol dialkyl glycerol tetraether (GDGT) lipids, analysed with high-performance liquid chromatography mass spectrometry (HLC-MS). Together, this allows for direct comparison between pulses of volcanic activity and changes to ocean temperatures in the same stratigraphic section.