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The Miocene warmth from the North Sea Basin perspective

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The Miocene climate was dynamic, oscillating between major glaciation events and greenhouse conditions (the so-called Miocene Climatic Optimum or MCO). However, forcing factors responsible for climatic transitions from one state to another are not fully understood, partly because palaeoclimatological records from northern mid to high latitudes are scarce.

To better resolve climatic changes of the Miocene epoch in the northern middle latitudes we studied a unique, nearly complete sedimentary record (Sdr. Vium borehole) spanning the upper Aquitanian to the Tortonian of the North Sea Basin. Newly obtained sea surface temperatures (SSTs) from our Miocene core revealed that the North Sea Basin was up to 20°C warmer than today, reaching the temperature maximum during the worldwide MCO (Herbert et al. 2020). Our high-resolution $\delta^{13}C$, TOC and C/N records, as well as elemental detrital ratios (Si/Al, Zr/Rb, Zr/Al) derived from XRF reveal important changes in the source of organic matter and detrital coarse fraction of the sediment. During the Miocene the location of the Sdr. Vium borehole was situated in a proximal setting, with water depths varying between 0 and ~200 m, partly due to advancing and retreating delta lobes and partly due to relative sea level changes. We observe that the depositional environment had a large impact on our record. By far the most important of these changes is a condensed interval associated with phosphatization, pyritization, and glauconite, associated with a major shift from a dark brown, organic-rich, bioturbated silty clay with thin sand lenses (the Hodde Formation) towards a green and brown clay with high concentrations of green glaucony pellets of fine sand grade (the Ørnhøj Formation). This shift is related to the subsidence of the North Sea Basin and marks the onset of a sediment-starvation in the basin.