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High Arctic paleoenvironmental and Paleoclimatic changes in the Mid-Cretaceous

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Although major progress in Cretaceous (145-66 Ma) paleoclimate and paleoceanography has been made during the last decades (e.g., Hay, 2008, 2011; Föllmi, 2012 and references therein), our knowledge of high latitudinal environmental change remains largely unknown compared to low- and mid-latitude marine and terrestrial environments. Drilling the Arctic Ocean remains challenging and expensive, whereas the Sverdrup Basin provides excellent exposures on land. To fully understand the climate and paleoceanographic dynamics of the warm, equable greenhouse world of the Cretaceous Period it is important to determine polar paleotemperatures and to study paleoceanographic changes in a well-established and continuous bio- and chemostratigraphic context. Exceptional exposures of Cretaceous sediments on the central to southern part of Axel Heiberg Island at a Cretaceous paleolatitude of about 71°N (Tarduno et al., 1998) provide a unique window on the Cretaceous Arctic paleoenvironment and climate history (Schröder-Adams et al., 2014).

Here we present high-resolution records combining sedimentological studies, U-Pb zircon geochronology, marine organic carbon isotopes and initial 187Os/188Os data, TEX86-derived sea-surface temperatures (SST) and climate modelling, that constrain the timing and magnitude of major Oceanic Anoxic Events (OAEs) and climate events constructed from a ∼1.8 km sedimentary succession exposed on Axel Heiberg and Ellef Ringnens islands in the Canadian Arctic Archipelago. The first high latitude application of initial 187Os/188Os data are agreeable with global profiles (Du Vivier et al., 2014) indicating the widespread magmatic pulse of the Caribbean Large Igneous Province (LIP) at the onset of OAE2 but also record the emplacement of local High Arctic LIP prior to the OAE2 in the Sverdrup Basin. Initial SST data suggest a slightly lower meridional temperature gradient during the Middle/Late Albian compared to present and a similar to the present one during the OAE2 period which shades a new light on temperature gradients during different climate states of the Cretaceous. In contrast, to the Late Cenomanian to Early Turonian the distinct occurrence of several widespread glendonite beds in the Late Aptian to Early Albian support cool bottom waters of about 0°C in the Arctic Sverdrup Basin, consistent with much lower TEX86-SST ∼28°C, McAnena et al., 2013) and bottom water temperatures (6°C, Huber et al., 2011) in the low latitude North Atlantic. This supports the global character of the proposed Late Aptian cold snap (Kemper, 1987; Herrle & Mutterlose, 2003; Mutterlose et al. 2009; McAnena et al. 2013) and perhaps a northern hemisphere high-latitude intermediate bottom water source.

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