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Understanding redox conditions in the mid-Cretaceous Baffin Bay - a combined model-data approach

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Cretaceous events of widespread oceanic anoxia are characterized by perturbations in the global carbon cycle and accompanied increased carbon burial in marine sediments. Their occurrence is thought to have been linked to an interaction of greenhouse conditions, palaeogeography and increased nutrient discharge, which led to enhanced surface productivity and improved conditions for carbon preservation. One of the most widespread oceanic anoxic events is the Cenomanian–Turonian boundary event (OAE2). Evidence for anoxic or even euxinic conditions during OAE2 is mainly observed in the Western Interior Seaway and at low- and mid-palaeolatitudes in the proto-Atlantic. However, our understanding of the distribution and characteristics of OAE2 in high palaeolatitudes is still incomplete. In order to investigate the palaeoceanographic conditions in high palaeolatitudes in the mid-Cretaceous, we studied the Umiivik-I stratigraphic core from West Greenland using an integrated approach combining sedimentology and geochemistry with three dimensional regional ocean modeling. Sedimentary rocks from the Umiivik-I core show relative high TOC contents with values up to about 5 %. The organic carbon-to-pyrite sulphur ratio (C/S-ratio) indicates that the organic matter (OM) is predominantly of normal marine origin. Increased C/S-ratios are caused by intermittent input of terrestrial OM and indicate fluctuations in runoff. Redox sensitive trace metal concentrations (e.g. Mo, U and V) were measured in bulk rock samples in order to reconstruct the redox conditions during the deposition. The concentrations of the trace metals (TM) are relatively low and in the same range as reported for average shale reference material. The low TM concentrations in the Umiivik-I core are indicative of deposition under oxygenated bottom water conditions in contrast to usually observed high TM concentrations in anoxic depositional environments during the mid-Cretaceous. These findings are exceptional due to the fact that the proto-Baffin Bay would have been preconditioned for anoxia because of basin geometry and high river nutrient discharge. This ongoing work aims to test and validate different hypotheses in a three dimensional regional ocean model (ROMS). The most important question going forward is how different palaeogeographic and ocean gateway configurations affect the regional ocean circulation and consequently the redox conditions in the proto-Baffin Bay area.