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High resolution carbon isotope stratigraphy and glendonite occurrences of the Christopher Formation, Sverdrup Basin (Axel Heiberg Island, Canada): implications for mid Cretaceous high latitude climate change

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Understanding the evolution of Canada's Arctic region, as a crucial component of Earth's climate system, is fundamental to assess short and long-term climate, environmental, and paleogeographic change. However, the stratigraphy and paleoenvironmental evolution of the Cretaceous Arctic is poorly constrained and a detailed bio- and chemostratigraphic correlation of major mid-Cretaceous paleoceanographic turning points such as Oceanic Anoxic Events, cold snaps, and biotic turnovers with key locations of the high- and low latitudes is missing. Here we present for the first time a high resolution bio- and carbon isotope stratigraphy of the Arctic Albian Christopher Formation of the Sverdrup Basin at Glacier Fiord in the southern part of Axel Heiberg Island, Canadian High Arctic. By using these techniques we developed a high temporal framework to record major environmental changes as it is indicated by the occurrence of glendonites and sandstone intervals of our studied Albian succession. The Albian Christopher Formation is a shale dominated marine unit with a thickness of approximately 1200 m. Several transgressive/ regressive cycles can be recognized by prograding shoreface units that break up mudrock deposition. In addition, glendonites are mainly found in the lower part of the Christopher Formation. Glendonites are pseudomorphs of calcite, after the metastable mineral ikaite, and have been often described from high latitude Permian, Jurassic and Cretaceous marine environments from the Canadian Arctic, Spitsbergen and Australia. The formation of glendonites takes place in the uppermost layer of the sediment and requires near-freezing temperatures, high salinity, and orthophosphate-rich bottom water. Although the presence of glendonites implies a range of paleoenvironmental conditions there is a consensus in the scientific literature that they reflect cooler paleoenvironmental conditions. Preliminary bio- and carbon isotope stratigraphic results suggest that the glendonites are concentrated in regular beds during the late Aptian to early Albian of the Christopher Formation supporting the idea of a cold snap (Kemper, 1987; Herrle & Mutterlose 2003; Mutterlose et al. 2009) within the mid-Cretaceous greenhouse period.

References

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