High Arctic record of Early Cretaceous climate and carbon-cycle perturbations: evidence from Spitsbergen, Svalbard

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The Early Cretaceous was characterised by high atmospheric CO_2 levels, and a long-term greenhouse climate. However, many studies suggest that short episodes of cooling and warming punctuated this greenhouse trend, often reflected in perturbations in the stable isotopic record. The magnitude of warming and cooling is still debated, as the various climate proxies do not agree necessarily with model predictions or each other, particularly with respect to Polar climates. Low pole-to-equator temperature gradients are suggested by various palaeothermometers, but these are not reproduced in climate models. Palaeo-high latitude sediments deposited at this time are of key importance to understand these global geochemical and climate changes, as the poles of the Earth are extremely sensitive to climate change. There is an on-going debate as to whether temperatures were ever low enough for small Polar ice-caps to develop, with possible glacial sediments being reported from the high latitudes (e.g. FRAKES et al., 1995), countered by temperature reconstructions from proxies such as calcite palaeothermometry and TEX_{86} that yield a range in temperature estimates.

The Svalbard archipelago preserves Lower Cretaceous sediments, and had a palaeolatitude of >60°N. These sediments are reported to contain both cold – and warm- climate indicators, such as dinosaur bones and footprints (HURUM et al., 2016); evidence for temperate forests (HARLAND & KELLY, 1997); paradoxically together with interpreted dropstones (DALLAND, 1977); and enigmatic “cold water” glendonites (e.g. PRICE & NUNN, 2010). However, due to poor dating and poor correlation between sites, the evidence can be contradictory and its palaeoclimatic significance unclear. We present data from a high-resolution carbon isotopic study of the Early Cretaceous succession on Svalbard, which, coupled with detailed sedimentological and petrological data, has allowed identification of significant global CIEs (which are all linked to climatic perturbations) and critical evaluation of the enigmatic sedimentological evidence (glendonites and outsized clasts) for cool climates, placing the Lower Cretaceous Succession of Spitsbergen in the context of global climate changes observed from other locations around the world.

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FRAKES et al., 1995. Int. Geol. Review, **37**/7, 567–583.
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HURUM et al., 2016. Geol. Soc. Spec. Pub., **434**/1, 189–206.
PRICE & NUNN, 2010. Geology, **38**/3, 251–254.