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Isotope variation in Valanginian glendonites and belemnites from Arctic Svalbard: Implications for Cretaceous ocean temperatures

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A number of different techniques have been used to estimate seawater temperatures of the past, although stable isotope analyses of biogenic carbonates are probably the most widely used. Using oxygen isotopes as a paleotemperature proxy in any marine environment requires an estimate of the isotopic composition of seawater. Other than in hydrodynamically open and stable situations (e.g. open ocean settings), estimations of seawater oxygen isotope composition are complex because of variables such as the input of freshwater and/or evaporation. This study examines a high latitude sedimentary succession from Svalbard that contains rocks of early Cretaceous (Ryazanian to Valanginian) age. A number of studies have suggested at least the presence of limited polar ice during this period of time. In order to evaluate high latitude climates during this period, two sections were examined on Svalbard, at Festningen and Janusfjellet. The Festningen section is known for its almost vertically inclined strata where a nearly continuous succession of sediments from Permian into Cretaceous is exposed along 5 km of beach cliffs at the mouth of Isfjorden. Both sections examined also contain within the shales anomalous pebbles (? dropstones) and in their uppermost part (late Valanginian) glendonites. Together they are consistent with short-lived episodes of cool or subfreezing conditions. Isotopic and geochemical analysis of fossil material (principally belemnites) provides data indicative of some samples being well preserved and suitable for further analysis. The isotopic analysis of the glendonites provides critical data regarding the isotopic composition of Cretaceous seawater. Together these isotopic data are suggestive of cool ocean temperatures during the Valanginian, not inconsistent with the presence of polar ice. Ice during the Cretaceous could explain purportedly synchronous and rapid changes of sea level recorded from passive continental margins.