

# Clumped isotope analyses of sub-Arctic early Cretaceous fossils: implications for seawater isotope values

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Here we present estimates of sub-Arctic marine temperatures and seawater isotope values obtained from Cretaceous fossil mollusk shells using the ‘carbonate clumped isotope’ method. The well-preserved Early Cretaceous (Valanginian) mollusk shells (belemnites) were derived from a number of high latitude locations in Siberia. From these analyses we infer average marine temperatures of 10-26°C. Our data are hence consistent with a warm ‘greenhouse’ world and near ice-free polar conditions. Our combined temperature and belemnite oxygen isotope data imply seawater isotope values that have a remarkably modern character in that they are similar to modern high-latitude seawater. We consider the seawater oxygen isotope values to be plausible and point to unexpected basin- or global-scale hydrologies. Our findings are consistent with modelling results that also suggest Cretaceous surface seawater oxygen isotope values are similar in many respects to modern.