

A high-resolution belemnite geochemical analysis of Early Cretaceous (Valanginian-Hauterivian) environmental and climatic perturbations

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The oxygen isotopic composition and Mg/Ca ratios of calcitic belemnites have been widely used to determine palaeotemperatures and the isotopic composition of seawater (and salinity) in Jurassic and Cretaceous times. Here we evaluate high-resolution temporal trends through the Early Cretaceous (Valanginian-Hauterivian) interval using carbon and oxygen isotopes and Mg/Ca ratios of belemnites from the Vocontian Trough (France) and SE Spain. A major positive carbon isotope excursion is evident in the Valanginian (within the Verrucosum ammonite zone) documenting a significant perturbation of the carbon cycle, i.e. the 'Weissert Event'. Combining data from the oxygen isotopic composition and the Mg/Ca ratios in the belemnite calcite allows us to evaluate changes in temperature and the oxygen isotopic composition of seawater. Changes in the latter have previously been interpreted in terms of changes in polar ice-volume. Our combined data suggest a cooling and a decrease in the oxygen isotopic composition of seawater (consistent with a decrease in salinity) during the peak of the 'Weissert Event'. These changes are synchronous between France and Spain. During the latest Valanginian and early Hauterivian further changes are evident whereby the oxygen isotopic composition of seawater becomes more positive, either a response to the formation of polar ice or a response changes in salinity.