THE CARBON AND OXYGEN ISOTOPIC RECORDS OF FOSSILS FROM THE LOWER OXFORD CLAY

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The excellent preservation of calcareous invertebrates and phosphatic vertebrates in the Lower Oxford Clay provides a good opportunity for paleo-oceanographic reconstruction based on stable isotopic abundances. We present here our initial results and interpretations on carbon and oxygen isotopic analyses on fossils of different depth habitats. Benthic fossils include epifaunal oysters and infaunal nuculacean bivalves. We also analyzed "pendant" bivalves whose depth habitat is uncertain. Fossil nekton are represented by ammonites and belemnites. Organisms that inhabited the uppermost part of the water column are represented by marine reptiles, such as icthyosaurs and plesiosaurs, and probable pelagic fish.

The oxygen isotopic compositions of calcareous benthos and nekton overlap substantially ($\delta^{18}O$ = -2 to +1 permil vs. PDB). The wide scatter in $\delta^{18}O$ values probably reflects physiological (non-equilibrium) effects in calcification rather than paleoenvironmental variations. Mean $\delta^{18}O$ values for oysters, pendant bivalves, and belemnites (all calcitic) and nuculacean bivalves (aragonitic) correspond to precipitation at isotopic equilibrium with non-glacial seawater at temperatures of 15°-18°C. The mean isotopic paleotemperature for ammonites (aragonitic) is slightly higher (20°C) but is probably not significantly different from those for other calcareous macro-invertebrates. Preliminary oxygen isotopic results on phosphate extracted from bones, teeth, and gill rays correspond to paleotemperatures of 20°-25°C.

Carbon isotopic results are limited to data from calcareous benthos and nekton. $\delta^{13}C$ values for individual taxa are quite variable (+2 to +5 permil for aragonitic fossils, 0 to +3 permil for calcitic fossils), suggesting physiological isotope effects. Nonetheless, mean $\delta^{13}C$ values are consistent with calcification in seawater having a carbon isotopic composition similar to that of modern average seawater. The presumably high flux of ^{13}C-depleted CO_2 into bottom waters from the diagenesis of sedimentary organic matter is not recorded in the carbon isotopic composition of benthic fossils.

Thermal stratification implied by the oxygen isotopic record suggests the penetration of cool, nutrient-rich waters into the Lower Oxford Clay sea. Upward advection of deep waters together with runoff from adjacent landmasses must have provided sufficient nutrients to maintain the inferred high productivity of surface waters. The influence of productivity on the carbon isotopic composition of surface waters will be tested by the analysis of calcareous phytoplankton.

https://doi.org/10.1017/S2475262200005670 Published online by Cambridge University Press