

Isotopes and elements from Mollusk shells: Tracing Cretaceous seasonality

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Abstract

Bivalve mollusks have been important producers of calcium carbonate since their origin in the Cambrium period. They are abundant in the fossil record as well as in the present day ecosystems. Their long evolutionary history and the great fossilization potential of their shells makes bivalves ideal targets for paleoenvironmental reconstruction. The calcium carbonate in bivalve shells is known to faithfully record proxies for the conditions of shell formation and can therefore be used to study paleoclimate in deep time. The incremental growth of bivalve shells allows for studying these paleoenvironmental proxies on a high temporal scale, which has led to the reconstruction of seasonal changes in deep time.

In this study, elemental abundances are measured in Cretaceous Rudist bivalve shells as well as modern bivalves in high spatial resolution using the new micro X-Ray Fluorescence (microXRF) scanner at the AMGC group of the Vrije Universiteit Brussel. This state of the art microXRF scanner allows for fast, non-destructive and statistically accurate measurements of elemental abundances in fossil material. It is faster and less destructive than other methods for obtaining elemental abundances and is therefore a promising tool for acquiring high-resolution (25 µm) proxy data on valuable samples that would not be available for destructive sampling.

Seasonal changes in elemental abundance ratios from the microXRF are interpreted together with profiles of stable carbon and oxygen isotope ratios through the same shells. Results from fossil shells are compared to their modern counterparts in order to validate paleoenvironmental proxies. Differences in absolute values of reconstructed environmental parameters as well as in their seasonal fluctuations between modern and fossil bivalve species are discussed, as well as their implications for the Cretaceous paleoenvironment of the Rudists. Finally, results of the novel microXRF method are compared with those from other methods for elemental analysis, and the accuracy and repeatability of the method for elemental analysis in carbonates is discussed.