High resolution trace element analysis in fossil bivalves: Perspectives from micro-XRF scanning

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Geochemical proxy records from marine bivalve shells offer a wealth of paleoenvironmental and palaeoclimatic information on a high temporal resolution. Chemical analyses of the shells of harvested or cultured well-known modern bivalves have shown that some geochemical proxies record conditions of the animal's environment (1). On the other hand, physiological processes controlling the growth and metabolism of the organism partly control shell chemistry (2). Multi-proxy geochemical analysis on the micrometer scale allows the disentangling of these different processes and isolation of the environmental component to enable paleoenvironmental reconstruction on the sub-annual timescale.

In this study, we apply the relatively new micro-X-Ray Fluorescence (µXRF) scanning technique (3) on late Campanian fossil bivalve shells to construct multi-proxy records through the shell. Not only does this technique allow high spatial resolution line scanning through the growth axis of the shell, but also chemical mapping of the entire polished shell surface to monitor shell preservation and the internal shell structure. The application of such high-resolution chemical analysis on different species of fossil bivalves from the same environment allows the comparison of the expression of paleoenvironmental and physiological proxies between bivalve species and the isolation of species-specific effects. Trace element analysis on these fossil shells sheds light on paleoenvironmental conditions in the Late Cretaceous Tethys Ocean as well as on the expression of geochemical proxies in fossil bivalves for which no culture experiments can be executed (e.g. rudists and extinct oysters).

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