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Inter-species variability in palaeoseasonality records from fossil bivalve shells: Evidence from Late Albian rudist and pectinid shells from the Lusitanian Basin, Portugal

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Palaeoclimate reconstructions are essential for improving our understanding of Earth's climate. Complementary to more commonly reported long term palaeoclimate reconstructions, much information can be obtained from palaeoclimate and –environment reconstruction on a shorter, seasonal time scale. Calcite shells of bivalves can provide the high resolution climate archives required for doing these reconstructions in deep-time. These organisms grow by incrementally adding carbonate to their shell, and are shown to precipitate stable oxygen isotope ratios in equilibrium with the ambient sea water, hereby recording past sea water composition and temperature (Klein et al., 1996). However, additional proxies such as stable carbon isotope and trace element ratios are required to disentangle the impact of various environmental parameters on the shell geochemistry (e.g. de Winter et al., 2017). The incorporation of these proxies into bivalve shells is not fully understood and often complicated by both species- or specimen-specific vital effects, diagenesis and variations in sea water concentrations (e.g. Gillikin et al., 2005; Freitas et al., 2008).

The current study aims at combining multi-proxy sclerochronological records (stable isotopes and trace elements) of different Late Albian bivalve taxa (rudists and pectinids) derived from the same proto-North Atlantic palaeoenvironmental setting in Portugal (Sao Julião section, Lusitanian Basin, Horikx et al., 2014). Micro-X-Ray Fluorescence (XRF) scanning yields quantitative line scans and semi-quantitative 2D maps that highlight the distribution of trace elements in the fossil shells. Trace element and stable isotope profiles - measured along the growth axis - allow for the identification of seasonal cycles recorded in the shell.
Here, a multivariate statistical approach is presented to identify the influence of different types of diagenesis on these multi-proxy records, and to isolate the seasonal cyclicity recorded in the shells. Results of this multi-proxy approach allow discussion of inter-species differences in preservation, seasonal cyclicity and incorporation of palaeoenvironmental proxies into the shell calcite. Most importantly, this approach sheds light on the feasibility of using the here investigated bivalve shells for future deep-time palaeoseasonality reconstructions.

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