

On the Potential of Bivalve Shells to Record Environmental Conditions: A LA-ICP-MS Study of Trace Element Distributions Along a Growth/Time Axis

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The shell chemistries of bivalves from the Scheldt Estuary (the mussel *Mytilus edulis*) and the bivalve *Isognomon ephippium* from Kenyan mangrove ecosystems were investigated by laser-ablation inductively-coupled-plasma mass spectrometry (LA-ICP-MS), with the objective to document the possible role of such biogenic carbonates as recorders of environmental conditions. High spatial/resolution profiles were obtained for Mg, Sr, Ba and Mn in the calcitic layer along the axis of maximum growth, from umbo towards the outer edge. The Mg profiles of the bivalves display cyclic variations with annual periodicity. For neither of the two species can Mg profiles be explained by seasonal variations in seawater composition. Mg variations are, however, partly related to sea surface temperature (SST) variations. However, for mussels from the Scheldt, the slope of the SST-Mg regression varies over the year and the regression may even break down completely, implying that SST can not be the sole factor controlling the Mg incorporation. The SST - Mg correlation is much stronger for some of the Kenyan bivalves, and shells from one particular site (Tudor Creek, Mombasa) show excellent co-variation between SST and Mg content. In both types of bivalves, the Sr profiles are highly similar to the Mg profiles and are not related to variations in the composition (Sr content) of the seawater. The strong similarity between the Mg and Sr profiles suggests that Sr incorporation is,

at least partly, Mg-dependent and/or temperature-dependent. However, the Sr seasonal variations in the Scheldt mussels can also be explained by shell growth rate. For the mangrove bivalves, the coincidence of some of the Sr maxima with Ba maxima, suggests that the incorporation of these two elements is controlled, at least in part, by a common third factor that might be related to plankton productivity. Thus, the Sr variations in the calcite layer of the bivalve shells are most probably controlled by an interplay between several factors. The Ba and Mn profiles for the two bivalve species are characterised by the presence of sharp maxima. For Scheldt mussels, these annual Ba maxima coincide with the spring phytoplankton bloom and presumably reflect elevated concentrations of particulate Ba associated with the algae. The same conclusion can be drawn for Mn. Similarly, the elevated skeletal Ba and Mn concentrations observed for the Kenyan bivalve shells can also be related with periods of high algal productivity, as they appear after the monsoon rainy periods which are known to trigger the phytoplankton blooms. We thus confirm that bivalve shells can represent useful records of environmental conditions over time spans of several years. However, the trace element distribution inside the shell calcite layer might be controlled by several factors which must be evaluated before such shells can become useful for reconstructing past environmental conditions.