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Mineralogical characterization of pristine, bio-eroded and fossil bivalve shell material for the evaluation of a species-specific alteration potential

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Biogenic carbonates of marine calcifiers can provide a wealth of information for the reconstruction of modern and palaeo-environments. However, their composite carbonate shells are often prone to different alteration processes that might occur during their lifetime, post-mortem or during early diagenesis. In order to use these calcifiers as palaeo-archives or proxy carriers, it is thus of crucial importance to assess their alteration potential.
Here, we present the mineral phase composition of four different Mediterranean bivalve species (Spondylus, Lithophaga, Arca, Glycymeris) using spatially selected, powder XRD analysis, as well as in-situ high-resolution Raman spectroscopy. The sample set thereby comprises pristine-modern, bioeroded-modern, Holocene and Pleistocene specimens of the same bivalve species in order to characterize and evaluate the species-specific susceptibility to bioerosion and diagenetic alteration.
We reveal species-specific shell compositions that are validated by both analytical methods. Differences in shell mineralogy occur between the outermost (periostracum), the outer (ostracum) and inner (hypostracum) layer, with the outer layer mainly composed of calcite and the inner layers of aragonite with variable portions of calcite. Considerable species-specific changes in mineralogy of the respective shell layers with increasing geological age are not found. Our results indicate that the original shell mineralogy (calcite, aragonite and carbonate fluorapatite) as well as the composition, structure and thickness of the respective shell layers are important factors favouring or preventing alteration to occur. Moreover, our findings highlight the effect of bioerosion during the alteration process. The analysis of distinct areas of the shells hinting at microbial activity reveals slight changes in shell mineralogy. We thus postulate that processes related to shell taphonomy are crucial for the shell's alteration/preservational potential and thus subsequent for diagenesis. This is a contribution to the DFG research group CHARON.