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Imprecision of paleotemperature and palaeosalinity reconstructions due to uncertainty in trace-element preservation and distribution in ostracod shells

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Ostracods, which are often abundant and well preserved in Quaternary sediments, have become a popular proxy for palaeoenvironmental studies. The trace element (Sr/Ca and Mg/Ca) geochemistry of fossil ostracod valves provide valuable information on palaeo-water composition and palaeotemperature. Despite this extensive use of trace-element ratios, relatively little is understood about their preservation or distribution within the shell. Studies using Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) or sequential dissolution of flow-through time-resolved analysis (FT-TRA) have suggested that for some species, the first $\sim$2 μm of trace-element data should be discarded due to an observed relative enrichment in Mg close to the shell surface. However, the uptake of trace-elements during shell calcification is not well understood and the enrichment could be a 'true' signal of the host water at the time of calcification. In addition, during whole shell dissolution and analysis with inductively coupled plasma optical emission spectrometry (ICP-OES), which is currently the most widely used method for trace-element analysis of ostracod shells, studies have shown that pre-treatment methods may result in partial dissolution of the calcite surface, thus biasing the trace-element/Ca (M/Ca) measurements. Here, we present LA-ICP-MS depth profiles, SEM imagery of internal shell structure, and the results of chemically induced calcite dissolution on M/Ca ratios. In combination, these methods provide insights into the potential imprecision of palaeotemperature and palaeosalinity reconstructions. We demonstrate that in marginal marine environments, the removal of surface enrichment either through pre-treatment or data being selectively removed, could bias temperature reconstructions up to 6 ˚C and increase conductivity reconstructions up to +4.5 mS cm^{-1}. With no universal method established, these results have implications for previous and future paleoenvironmental reconstructions.