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Trace elemental alterations of bivalve shells following transgenerational exposure to ocean acidification: Implications for geographical traceability and environmental reconstruction

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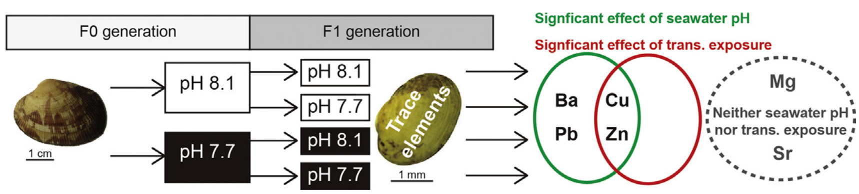
HIGHLIGHTS

- Neither seawater pH and transgenerational exposure affects the Mg and Sr composition of bivalve shells.
- With decreasing seawater pH, the amounts of Cu, Zn, Ba and Pb taken up in clam shells increase.
- Transgenerational exposure to seawater acidification affects the Cu and Zn composition of bivalve shells.

GRAPHICAL ABSTRACT



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ABSTRACT

Trace elements of bivalve shells can potentially record the physical and chemical properties of the ambient seawater during shell formation, thereby providing valuable information on environmental conditions and provenance of the bivalves. In an acidifying ocean, whether and how seawater acidification affects the trace elemental composition of bivalve shells is largely unknown. Here, we investigated the transgenerational effects of OA projected for the end of the 21st century on the incorporation of trace elements into shells of the Manila clam, *Ruditapes philippinarum*. Neither seawater pH nor transgenerational exposure affected the Mg and Sr composition of the shells. Compared with clams grown under ambient conditions, specimens exposed to elevated CO_2 levels incorporated significantly higher amounts of Cu, Zn, Ba and Pb into their shells, in line with the fact that at lower pH, these elements in seawater occur at higher fractions in free forms which are biologically available. Transgenerational effects manifested themselves significantly during the incorporation of Cu and Zn into the shells, most likely because Cu and Zn are biologically essential trace elements for metabolic processes. In addition, the plasticity of metabolism toward energetic efficiency following transgenerational exposure confers the clams enhanced ability to discriminate against Cu and Zn during the uptake from the ambient environment to the site of calcification. In the context of near-future OA scenarios, these findings may provide unique insights into the two primary applications of trace elements of bivalve shells as geographical tracers and proxies of environmental conditions.

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