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Environmental and biological factors influencing trace elemental and microstructural properties of *Arctica islandica* shells

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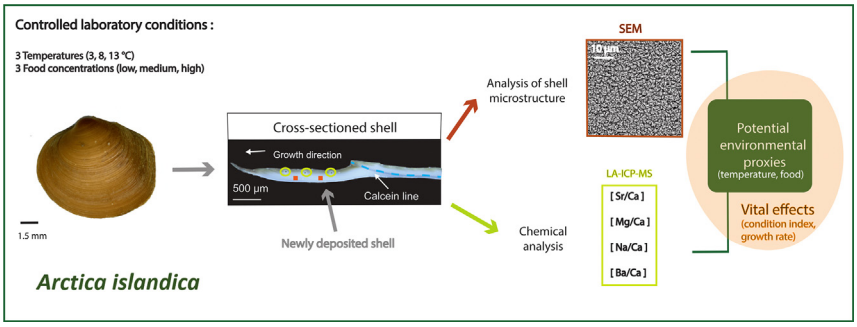
HIGHLIGHTS

- Incorporation of Na, Mg, Sr, and Ba in *A. islandica* shell is affected by growth rate.
- Shell impurities do not directly reveal the temperature or food conditions.
- A relationship between Ba peaks and food concentration could not be detected.
- SEM analysis shows no influence of food and temperature on shell microstructure.

GRAPHICAL ABSTRACT



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ABSTRACT

Long-term and high-resolution environmental proxy data are crucial to contextualize current climate change. The extremely long-lived bivalve, *Arctica islandica*, is one of the most widely used paleoclimate archives of the northern Atlantic because of its fine temporal resolution. However, the interpretation of environmental histories from microstructures and elemental impurities of *A. islandica* shells is still a challenge. Vital effects (metabolic rate, ontogenetic age, and growth rate) can modify the way in which physiochemical changes of the ambient environment are recorded by the shells. To quantify the degree to which microstructural properties and element incorporation into *A. islandica* shells is vitally or/and environmentally affected, *A. islandica* specimens were reared for three months under different water temperatures (3, 8 and 13 °C) and food concentrations (low, medium and high). Concentrations of Mg, Sr, Na, and Ba were measured in the newly formed shell portions by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). The microstructures of the shells were analyzed by Scanning Electron Microscopy (SEM). Shell growth and condition index of each specimen were calculated at the end of the experimental period.

Findings indicate that no significant variation in the morphometric characteristics of the microstructures were formed at different water temperatures or different food concentrations. Shell carbonate that formed at lowest food concentration usually incorporated the highest amounts of Mg, Sr and Ba relative to Ca^{+2} (except for Na) and was consistent with the slowest shell growth and lowest condition index at the end of the experiment. These results seem to indicate that, under food limitation, the ability of *A. islandica* to discriminate element

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