PP43F-1727 Assessing species-specific oxygen isotopic temperature calibrations for Gulf of Maine bivalves

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Abstract:

Oxygen isotope records from mollusk shells have been used extensively to reconstruct past ocean temperatures and hydrographic conditions. Due to its centuries-long lifespan, *Arctica islandica* is commonly used in paleoclimate reconstructions, while mollusk species with shorter lifespans, such as *Mya arenaria,* are often preserved in indigenous shell heaps from thousands of years ago. Current reconstructions implement an oxygen isotope-water temperature calibration derived from multiple species of aragonite mollusks (Grossman and Ku, 1986). To test for species-specific differences in the oxygen isotope-water temperature relationship, three Gulf of Maine mollusk species (*Mercenaria mercenaria, M. arenaria,* and *A. islandica*) were grown in controlled temperature treatments (6.21 ± 0.06, 8.91 ± 0.28,11.83 ± 0.14°C) in a flow-through laboratory experiment for twenty weeks. We measured the $d^{18}O$ of the seawater ($d^{18}O_w$) in each tank throughout the experiment and the $d^{18}O$ of the growing edge of each shell ($d^{18}O_c$) at the conclusion of study ($n_{mya} = 56$, $n_{mer} = 46$, $n_{arc} = 22$). The $d^{18}O_c$ values for replicate individuals from the same species and tank agreed within ~± 0.2-0.6 ‰ (±1 SD, n = 4-10 replicates per species), which is above the analytical uncertainty of ~±0.09‰. Both $d^{18}O_w$ and $d^{18}O_c$ were used to calculate temperature using the calibration equation determined by Grossman and Ku (1986). Preliminary temperatures calculated from *M. arenaria* and *M. mercenaria* $d^{18}O_c$ values using the Grossman and Ku equation differed significantly from the measured tank temperatures ($P < 0.05$ for *M. arenaria* and *M. mercenaria* at all three temperatures), predicting temperatures that were ~1-4°C cooler and ~2-6°C warmer, respectively. Temperatures calculated from *A. islandica* $d^{18}O_c$ using the Grossman and Ku equation generally agreed with measured temperatures for each treatment. Based on these findings, the use of species-specific calibration equations may be necessary to account for differences in the ways that mollusk species such as *M. mercenaria* and *M. arenaria* record temperature. Conversely, our findings broadly reinforce the use of Grossman and Ku's multi-species calibration for oxygen isotope records from *A. islandica,* though the relationship at lower temperatures may need to be studied further.