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Sclerochronologicial and isotope (δ^{18}O) analyses of *Panopea abrupta* (bivalve mollusk) shells from Protection Island (Washington, USA)

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Cardinal tooth sections of geoducks (*Panopea abrupta*) are increasingly used to reconstruct the past variability of the Pacific Decadal Oscillation (PDO) and El Nino / Southern Oscillation (ENSO). These bivalves are extremely long-lived (up to 160 years), exhibit a broad biogeographic distribution and reliably record changes of water temperature in the form of variable growth increment widths in these shells. However, little is known about potential isotopic disequilibrium fractionation in umbonal shell portions or how intra-annual growth rates vary during ontogeny (e.g., changes in the duration of the growing season or variable growth rates at different times of the year). We have therefore studied the sclerochronology and oxygen isotope ratios of different shell layers of this species. According to our findings, the shells grow from March through October with maximum shell extension rates (max. 180μm per growing season, umbo) during the warm summer (August) and negligible rates during the cold winter months. Shell growth patterns are clearly discernable in umbonal shell portions, but less so in the outer (primary) shell layer near the ventral margin. Temperatures reconstructed (Böhm et al. equation) from the oxygen isotope values taken from the outer shell layer compare well with instrumental water temperatures, whereas δ^{18}O values from the umbo differ by up to 3˚C. These findings suggest the following sampling strategy: (1) annual increment widths should be measured in umbonal shell portions; (2) intra-annual δ^{18}O values cannot simply be arithmetically averaged, but instead require weighted averaging; (3) isotope geochemical analyses should be

exclusively performed along the outer, primary shell layer. Results of our study are prerequisite for paleoclimate studies using *P. abrupta*.