Development of the boron isotope pH proxy in Arctica islandica shells

Alan D. WANAMAKER[1*], Diana THATCHER[1], Joseph STEWART[2], Branwen WILLIAMS[3], Heidi FRANKLIN[4], Katherine GUAY[4], Brittany JELLISON[5], Nina WHITNEY[6], Teagan MCMAHON[3], Lindsey JAROSINSKI[1], Michèle LAVIGNE[4]

[1] Department of Geological and Atmospheric Sciences, Iowa State University, 253 Science Hall, 2237 Osborn Drive, Ames, IA, 50011, USA
[2] School of Earth Sciences, University of Bristol, Wills Memorial Building, Queens Road, Bristol, BS8 1RJ, UK
[3] Keck Science Department, Claremont McKenna-Pitzer-Scripps Colleges, 888 Columbia Avenue, Claremont, CA 91711, USA
[4] Department of Earth and Oceanographic Science, Bowdoin College, 255 Maine Street, Brunswick, ME, 04011 USA
[5] Department of Biological Sciences, University of New Hampshire, 270, Durham, NH 03824
[6] Marine and Coastal Science, University of Western Washington, 516 High Street, Bellingham WA 98225

* adw@iastate.edu

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Coastal systems can exhibit large variability in pH compared to open marine conditions, thus the impacts of ocean acidification (OA) on their resident calcifying organisms are potentially magnified. Further, our understanding of the natural baseline and variability of pH is spatially and temporally limited in coastal settings. In the few coastal locations that have been monitoring seawater pH, records are generally limited to <10 years and are thus unable to provide the full range of centennial to decadal natural variability. This is the case for the Gulf of Maine (northwestern Atlantic), a highly productive region of strategic importance to U.S. fisheries, that is facing multiple environmental stressors including rapid warming and threats from OA. Paleoceanographic proxy records are therefore much needed in this region to reconstruct past pH conditions beyond instrumental records. A clear candidate for this is the boron isotope ($\delta^{11}B$) pH proxy provided the $\delta^{11}B$ sensitivity to pH in long-lived shallow water marine carbonates can be established.

To this end, we grew juvenile and adult *Arctica islandica* (ocean quahog) in flowing seawater tanks for 20.5 weeks in controlled pH (7.4, 7.6, 7.8 or 8.0 (ambient) ± 0.02) and temperature (6, 9 or 12 ± 0.56 °C) conditions at Bowdoin College's Schiller Coastal Studies Center, Harpswell, Maine (USA). The clams were stained twice with calcein and supplemented with food (Shellfish Diet) throughout the experiment to ensure suitable growth. New shell growth (average 67% increase in maximum shell height and 522% increase in buoyant weight across all treatments), constrained by calcein markings, were sampled for boron isotope analysis ($\delta^{11}B$) to determine if shell $\delta^{11}B$ varied as a function of pH similar to many other calcifying organisms. The results of the culture experiment will yield whether or not *Arctica islandica* preserves seawater pH information in their shells. If so, the transfer function relating shell $\delta^{11}B$ to pH will be used to hindcast pH in the central coastal region of the Gulf of Maine during recent centuries. Alternatively, if the shell $\delta^{11}B$ signal is independent of ambient seawater pH, this may reveal the capacity of *Arctica*