The potential of oyster shell in alleviating ocean acidification in Narragansett Bay

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Background

The growth of bivalve shells removes water alkalinity (ALK) when forming the calcium carbonate shells. The dead shells dissolve when the water is too acidified (generally in the bottom water when oceanic carbon dioxide (CO2) is too high. The shell dissolution release the ALK back to the water column and remove CO2, working as the antacids and alleviating the ocean acidification. However, the bivalve's shells are generally categorized as solid waste and are not recommended to be returned to public tidewaters, even though studies have confirmed their benefits in supporting oyster growth and recruitment by providing setting substrates (Nestlerode et al., 2007, Graham et al., 2017). Additionally, little attention has been given to quantifying the shell dissolution in alleviating water acidification and removing CO2. National Academies of Science ocean-based CDR research plan (NASEM, 2021) suggests that ocean alkalinity enhancement (OAE) is a promising carbon dioxide removal (CDR) approach. Finding the right alkalinity supply substrate is one of the great challenging to develop this CDR approaches. While we acknowledge that bivalve shells are often insufficient to reverse coastal ocean acidification, understanding its potential to restore coastal ALK may have great ecosystem benefits in local estuaries, where ALK is removed in the first place. Based on the above discussion, this project aims to determine the potential of shell dissolution in alleviating water acidification and CDR. The finding may help us propose alternative environmental regulation actions to benefit aquaculture and grow the blue economy.

Major Research Activities

1. Collect fresh oyster shells from local restaurants in the first week;
2. Crush the shells into ~1 mm size in the second week;
3. Add these processed shells to the experiment incubators. One of the incubator's pCO2 levels is 400 ppm by bubbling air into the incubator. In contrast, the other incubator will be maintained at 1000 pm by bubbling high concentration of CO2 gas. The student will measure the dissolved inorganic carbon (DIC) and ALK for each treatment every 12 hours for from week 3 to 8.
4. By comparing DIC and ALK concentration between the experiment and control treatments (without crushed oyster shells), the student will examine the rate of oyster shell dissolution, and then quantify the CDR rate, and ocean acidification changes from week 9 to 10.

Others

The project must be done in residence.
The applicant should have some basic statistical analysis skills and a basic understanding of marine chemistry, such as pH and alkalinity.
The prospective student can contact me directly at hwang@uri.edu.

Reference

Nestlerode, J. A. et al. (2007). Settlement and survival of the oyster crassostrea virginica on created oyster reef habitats in Chesapeake Bay. *Restoration Ecology*, *15*(2), 273–283. https://doi.org/10.1111/j.1526-100X.2007.00210.x

Graham, P. M. et al. (2017). Oyster reef restoration: substrate suitability may depend on specific restoration goals. *Restoration Ecology*, *25*(3), 459–470. https://doi.org/10.1111/rec.12449

NASEM (2021). *A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration*. *A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration*. The National Academies Press. https://doi.org/10.17226/26278