Swimmers and settlers: Olivine as a settlement substrate is not the top choice for the Pacific oyster (*Magallana gigas*)

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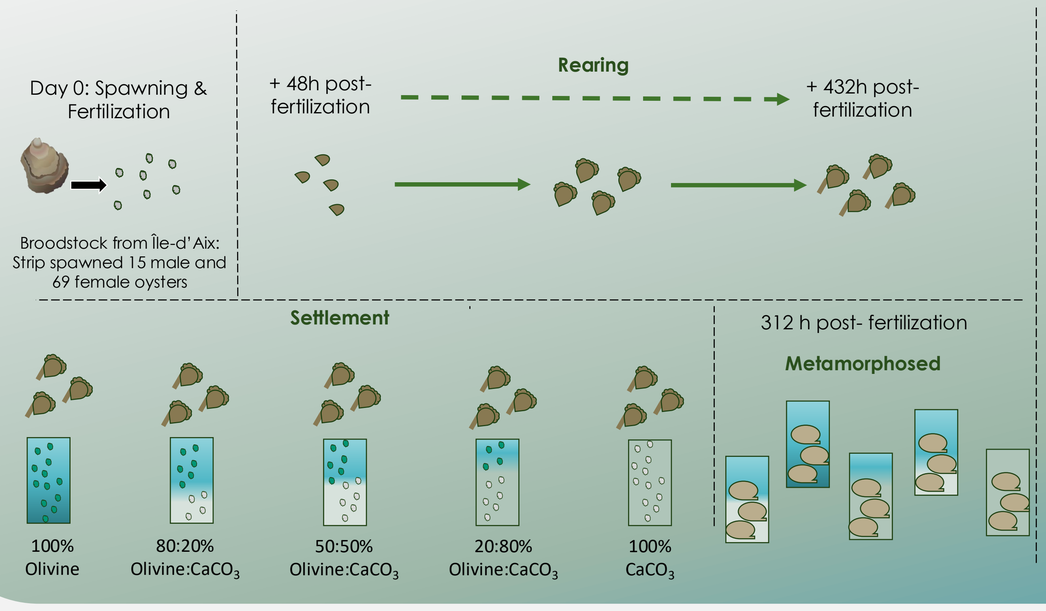
Background: OAE

- Ocean alkalinity enhancement via mineral dissolution is a geoengineering method aimed at reducing seawater CO_2 which enhances the Ocean's capacity to take up excess atmospheric CO_2.
- The mineral olivine is a Mg-Si mineral with the potential to buffer excess H^+ in seawater when dissolved. Upon application, it is plausible that undissolved fine-grain minerals will fall out of suspension and onto the substrate.
- **Objective: Examine the effects of olivine as substrate for oyster (*M. gigas*) larval settlement**

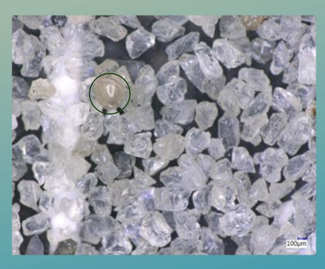
Experimental design



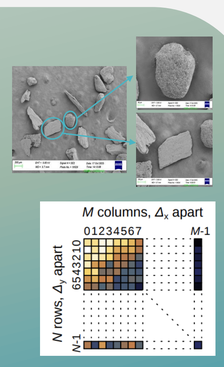
Competent pediveliger oyster larvae were stocked

~5 larva ml^{-1} (total 25,000)

5 treatments 3x replicates

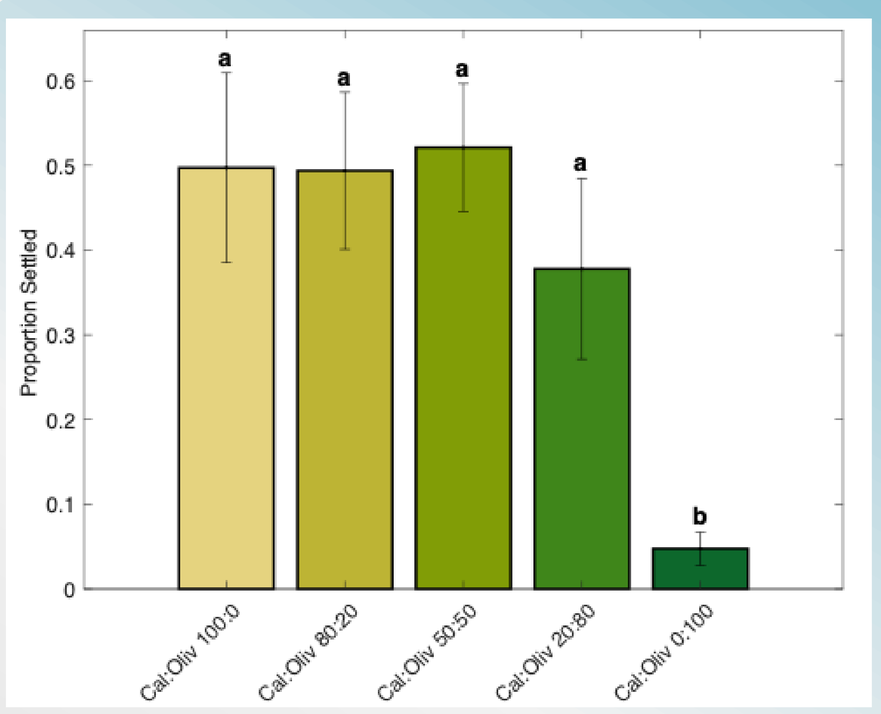


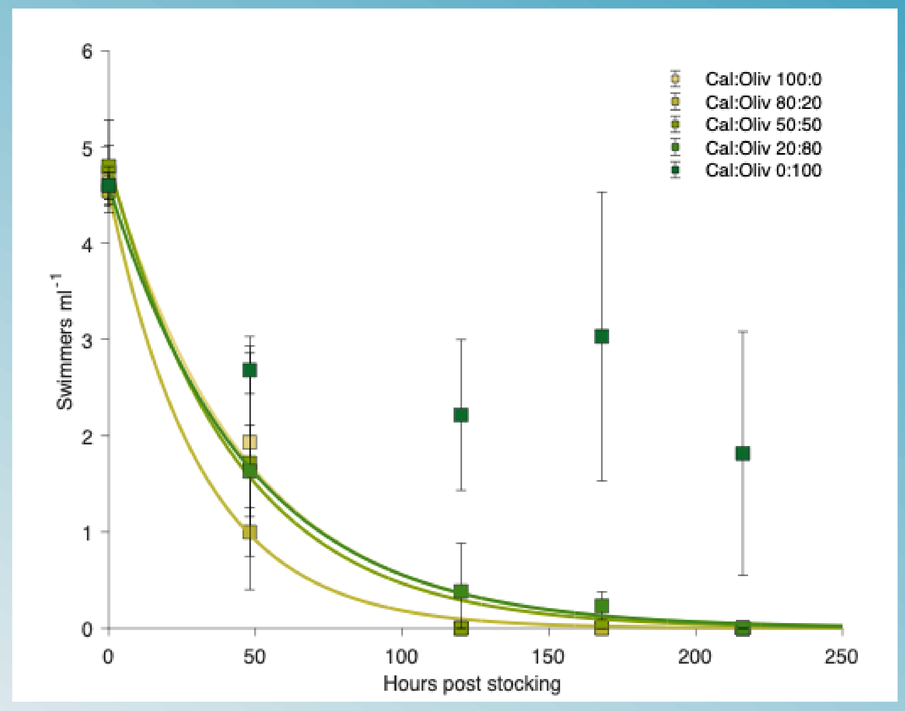
Gwyddion App[1] ( ): used to determine mineral roughness, by examining greyscale intensity from SEM imaging to create relative topographical heights on a mineral surface[2] from 15 Olivine grains and 15 $CaCO_3$ grains (separated as porous or layered)

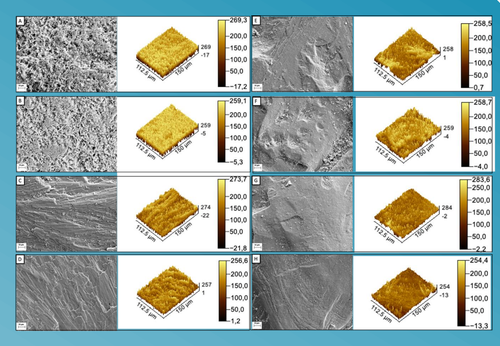


Qualitative assessment of mineral preference was assessed by selecting a random subsample of 25 settled larvae from the Olivine:$CaCO_3$ 80:20 treatment using SEM imaging and EDS

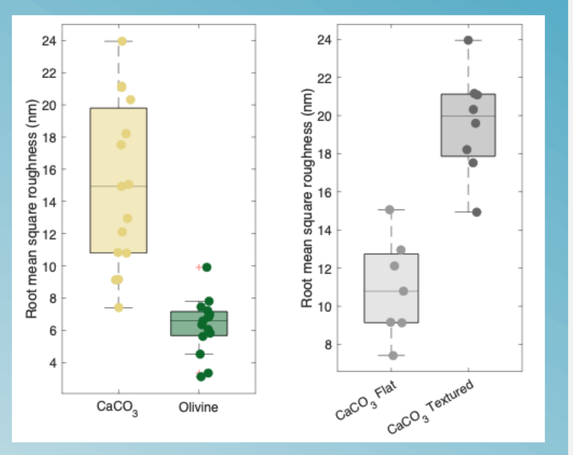
Results



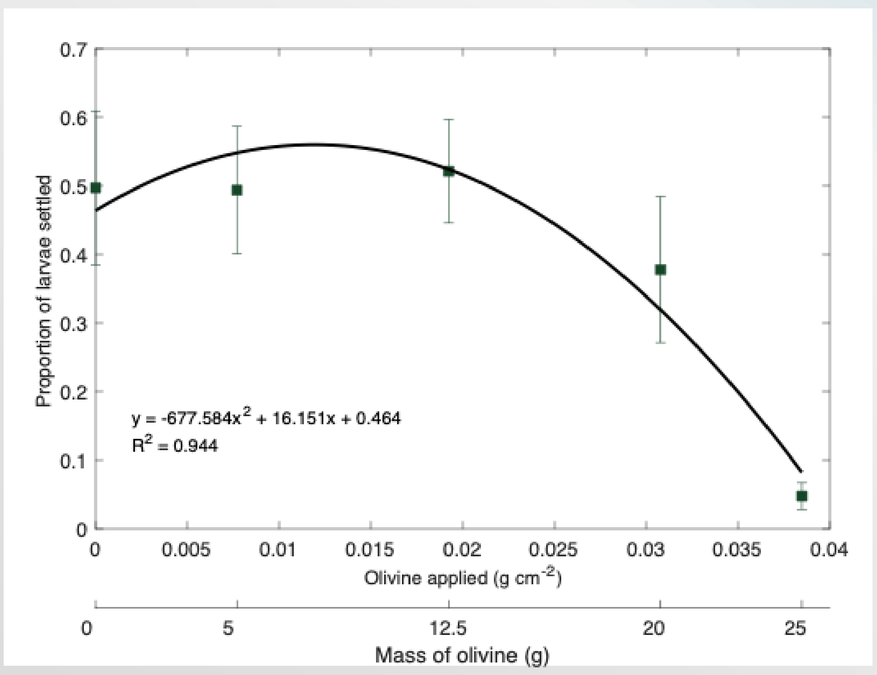


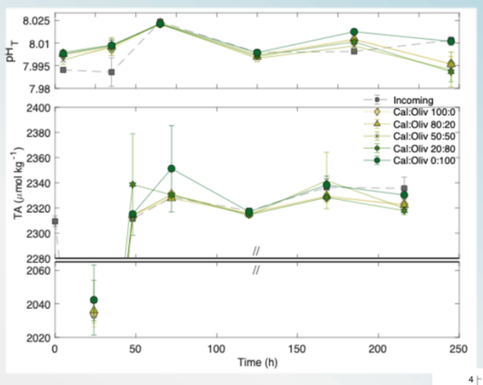


$CaCO_3$ had a more complex texture, compared to olivine, however, $CaCO_3$ were diverse and categorized as being 'flat' or 'textured.'



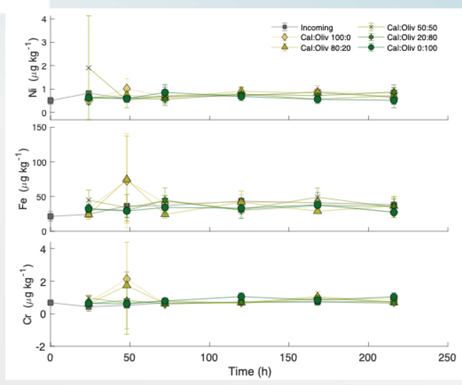
72% of larva settled on $CaCO_3$. Of the remaining 28%, half had $CaCO_3$ attached to the umbo, while the olivine grains were primarily located along the shell edges.

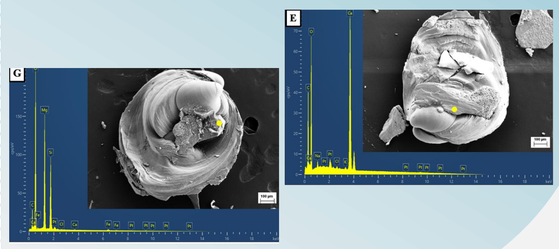




TA significantly different at 216 H for100% Olivine

No evidence of alkaline mineral dissolution





Conclusions

- Oyster larval settlement was ~ 90% lower under the 100% olivine treatment compared to all other treatments.
- Swimming larvae were retained in the100% olivine treatment up until 216 h post stocking while swimmers were zero between 100 – 150 h post stocking for the three treatments with the highest proportions of $CaCO_3$
- Qualitative assessment displayed $CaCO_3$ as a preference substrate over olivine, while flat, less textured, $CaCO_3$ fragments were preferred compared to high textured fragments.
- $CaCO_3$ grains where significantly higher with respect to roughness compared to olivine grains.

References: 1. D. Nečas, P. Klapetek, Gwyddion: an open-source software for SPM data analysis. *Open Physics* **10**, 181–188 (2012).
2. D. Sinkhonde, Quantitative study on surface porosity and roughness parameters of mineral and organic admixtures based on multi-scale characterisation techniques. *Cleaner Materials* **7**, 100166 (2023).

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