

Assessing the Response of Suspended Particulate Matter Stoichiometry to Ocean Alkalinity Enhancement (OAE)



Figure 1. Main principle of Ocean Alkalinity Enhancement (OAE). Mineral dissolution consumes hydrogen ions and releases cations, thereby inducing a shift of the carbonate system towards bicarbonate and carbonate and decreasing the partial pressure of CO_2 . Source: Bach et al. (2019)

- Approach: Increase of surface water alkalinity to enhance atmospheric CO_2 uptake and storage.
- Little knowledge about potential environmental risks and co-benefits, yet.
- Impact expected especially on primary producers.
- Organic matter (OM) stoichiometry is a valuable tool to estimate changes in the ecosystem.

2. THE EXPERIMENT

- Application of un-equilibrated OAE
- Location: Raunefjord, Bergen, Norway
- Time: May July 2022 (53 days)



Figure 2. Experimental Design. Values show ΔTA in [µmol·kgSW⁻¹]. 2 x 5-level alkalinity gradient. CaCl₂ and MgCl₂ in proportion to OAE level (1:2) for Ca-based mineral simulation and Si-based mineral simulation, respectively. Ambient TA $\approx 2180 \,\mu\text{mol}\cdot\text{L-1}$.

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- 3.1. – Phytoplankton Community



- 3.2. – Particulate Organic Matter (POM) Stoichiometry



4. CONCLUSIONS

ratio of the

alkalinity in the

silicate-based

- high primary production:

 - in the water column

Bach, L. T., Gill, S. J., Rickaby, R. E. M. & Renforth, P. (2019). CO₂ removal with enhanced weathering and ocean alkalinity enhancement: Potential risks and co-benefits for marine pelagic ecosystems. Frontiers in Climate, 1 https://doi.org/10.3389/fclim. 2019.00007

Positive correlation between the C:N suspended OM and mineral simulation after nutrient addition

3. RESULTS

Figure 4. Biogeochemistry of POM relative to alkalinity after nutrient addition. (A.) Ratio of particulate organic carbon (POC) to particulate organic nitrogen (PON) in the water column (WC). (B.) Difference of POC:PON ratio between WC and sediment (Sed). (C.) Amount of POC in the Sed relative to WC. (D.) Amount of PON in the Sed relative to WC.

Pigment analysis indicate **no impact** of alkalinity or mineral type on the biomass of the two major phytoplankton groups Alkalinity effects in the silicate-based OAE simulation during

• Alkalinity is affecting the C:N ratio of the suspended OM • The C:N ratio of the OM in the water column is increasing with alkalinity, potentially driven by enhanced organic carbon retention









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EGU General Assembly, Vienna, April 2023 presentation poster. Work is ongoing and unpublished. Conclusions are preliminary and may be subject to slight changes during finalization.





No alkalinity or mineral effect on phytoplankton pigment concentrations in the phase after nutrient addition



