idw - Informationsdienst Wissenschaft
Nachrichten, Termine, Experten

Press release

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
Ilka Thomsen

12/06/2024
http://idw-online.de/en/news844384

Research projects, Research results
Biology, Chemistry, Environment / ecology, Oceanology / climate, Zoology / agricultural and forest sciences
transregional, national

How do marine food webs respond to increasing alkalinity? First study shows promising results

06.12.2024/Kiel. To mitigate climate change, carbon dioxide emissions must be reduced quickly and drastically. Additionally, some of the CO_2 already emitted needs to be removed from the atmosphere. One solution is to enhance the ocean's uptake of CO_2 by increasing its alkalinity. The method mimics the natural process of rock weathering by adding ground rock, or its dissolution products, directly to the seawater. Little is known about the method's effects on marine life. A new study has assessed the impacts of a moderate OAE application, showing that the effects on zooplankton are likely minimal and that the food web could remain stable. The results are published today in Science Advances.

The ocean naturally absorbs a quarter to a third of man-made CO_2 emissions, but this process also leads to the acidification of seawater. By increasing the alkalinity of seawater through the addition of certain minerals (e.g., carbonates and silicates), the ocean can chemically bind more CO_2 without further acidification. However, there is still little research on the environmental effects of Ocean Alkalinity Enhancement (OAE). Scientists from Prof. Ulf Riebesell´s group at GEOMAR Helmholtz Centre for Ocean Research Kiel, as part of the European oceanNETs project, have now investigated the response of zooplankton and potential impacts on the food web for the first time in an experiment conducted off Gran Canaria. The results of their study are published today in the journal Science Advances.

Experimenting in giant test tubes

The study adopted an approach with moderate perturbations to seawater chemistry: CO⍰-equilibrated Ocean Alkalinity Enhancement. With this approach, the alkalised water that has already absorbed CO_2 intended for carbon dioxide removal (CDR) before being released to the marine environment. For their experiment, the scientists used KOSMOS mesocosms (Kiel Off-Shore Mesocosms for Ocean Simulations) - large test tubes that are lowered directly into the seawater, isolating eight cubic metres of the water column.
Different concentrations of sodium carbonate and bicarbonate were added to achieve varying intensities of CO_2-equilibrated OAE, ranging from no increase in alkalinity to a doubling of natural alkalinity. Over a period of 33 days, the researchers monitored the effects of alkalinisation on zooplankton, which plays a key role in transferring energy through the food web up to fish. A range of responses were studied in the zooplankton, from biomass and production to diversity and fatty acids.

Overall, researchers found that the plankton communities remained stable and that the zooplankton largely tolerated the moderate chemical changes associated with CO_2-equilibrated OAE. During the experiment, the nutritional quality of the particulate matter on which zooplankton can feed potentially deteriorated, but this did not seem to affect the consumers. The researches argue that food limitation, a result of the oligotrophic conditions under which this experiment took place, and which characterize subtropical waters, could have buffered these possible indirect responses of zooplankton to OAE.

“Our study shows that the increase in alkalinity has minor impacts on the zooplankton and that the food web as a whole remains stable,” says Nicolás Sánchez, PhD student and first author of the study.

Potential in climate protection and need for further research

Ocean Alkalinity Enhancement could become an important ally in reducing CO_2 emissions to combat climate change. By enabling the ocean to absorb more CO_2 without becoming more acidic, this approach could strengthen the ocean’s role as a buffer against global warming. It could help bridge the transition to a future where fossil fuels are replaced by renewables, emissions from industries that cannot be decarbonized are neutralised, and historical carbon emissions are safely removed and stored. However, extensive research is urgently needed in order to determine the impact of OAE on the whole marine environment.

“Our experiment has shown that CO_2-equilibrated OAE does not have a lasting impact on zooplankton and the food web in the nutrient-poor subtropical area we studied,” says Nicolás Sánchez, “but this does not say anything about how it will affect other marine environments, nor about the safety of other, technically more feasible forms of OAE that cause greater changes to seawater chemistry”.

The scientists recommend further research on the method and across different ecosystems, as there will not be a single OAE approach that can be applied everywhere. Sánchez: “Our study is a promising first step towards defining a responsible framework for the application of alkalinity enhancement.

Funding:
The OceanNET (Ocean-based Negative Emission Technologies) project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement number 869357.

Original publication:

Sánchez, N., Goldenberg, S., Brüggemann, D., Taucher, J., & Riebesell, U. (2024). Plankton food web structure and productivity under Ocean Alkalinity Enhancement. Science Advances.
https://doi.org/10.1126/sciadv.ado0264

URL for press release: http://www.geomar.de/n9695 Image material available for download

URL for press release: https://www.geomar.de/en/fb2-bi/biogeochemical-processess Prof. Ulf Riebesell´s working group

URL for press release: http://Biogeochemical Processes

URL for press release: https://www.oceannets.eu/ OceanNETs

URL for press release: https://www.oceanblogs.org/oceannets/ OceanNETs Blog