EGU24-12043, updated on 07 Dec 2024
https://doi.org/10.5194/egusphere-egu24-12043
EGU General Assembly 2024

Reassessing the role of diatoms in carbon transfer through the Southern Ocean Twilight Zone

Jack Williams[1], Sari Giering[2], Chelsey Baker[2], Hannah East[2], Benoit Espinola[2], Fred Le Moigne[3], Maria Villa[4], Katsiaryna Pabortsava[2], Sabena Blackbird[5], Corinne Pebody[2], Kevin Saw[2], Mark Moore[1], Stephanie Henson[2], Richard Sanders[2], and Adrian Martin[2]

[1]School of Ocean and Earth Science, University of Southampton, Southampton, SO14 3ZH
[2]National Oceanography Centre, European Way, SO14 3ZH, Southampton, U.K.
[3]Univ Brest, CNRS, IRD, IFREMER, Laboratoire des sciences de l'environnement marin, 29280 Plouzané, Technopôle Brest-Iroise, France
[4]Dpto. Física Aplicada II, Universidad de Sevilla, ETSIE. Av. Reina Mercedes 4A, Sevilla, 41012, Spain
[5]School of Environmental Sciences, University of Liverpool, L69 3BX, Liverpool, U.K

Diatoms, a ubiquitous group of phytoplankton, account for approximately 40% of particulate organic carbon (POC) exported via the ocean biological carbon pump, which modulates atmospheric CO_2. Diatoms are represented in global biogeochemical models as effective vectors for sinking POC, with their large size and dense skeletons made of biogenic Silica (BSi) thought to allow rapid transfer of organic carbon to the ocean interior. However, we observe this not to be the case across large parts of the Southern Ocean mesopelagic zone. Here we present direct flux measurements from different sectors of the Southern Ocean demonstrating that silica and carbon cycles in the Southern Ocean mesopelagic are strongly decoupled, with a weak mechanistic link between BSi and POC fluxes. By combining Marine Snow Catcher flux measurements, in-situ pump, and CTD particulate data, we show that for a large part of the productive season, diatoms do not represent efficient vectors of sinking POC through the mesopelagic, yet POC is still efficiently transferred to depth. We suggest that processes influencing flux attenuation differ between the upper mesopelagic and deep ocean, with rapid BSi flux attenuation in the upper mesopelagic caused by elevated rates of BSi remineralization or negation of biomineral ballast effects by particle processes such as buoyancy regulation or fragmentation. Biomineral ballast may yet play an important role in shaping the efficiency of sinking POC transfer in the deep ocean. More broadly, these results highlight the need to understand the nuanced role this key taxon plays in transferring carbon through the mesopelagic, a region that is highly vulnerable to climate change effects and key in shaping the efficiency of downward carbon transport. As diatoms appear to be inefficient at delivering carbon to the deep ocean, projected losses in the strength of the Southern Ocean BCP due to shifts in phytoplankton community composition to smaller size classes may be less than previously predicted.