Spatiotemporal distribution, diversity, and export fluxes of diatoms in the North Pacific Subtropical Gyre

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Diatoms are well known for their great contribution to particulate carbon exported to depth as part of the biological pump. However, little is known about their contribution of carbon sink in the North Pacific Subtropical Gyre (NPSG), one of the largest oligotrophic ocean areas in the world. Here, we used taxonomic analysis to investigate spatiotemporal distribution, diversity, and export fluxes of diatoms in NPSG based on two ocean scientific surveys during 2020-2021. Our results showed that the abundances of diatoms in the stations analyzed were between 20 - 2110 cells L⁻¹, being 1-3 orders of magnitude lower than that in coastal ocean. Highest biomass of diatoms was found in M35 site in summer, mainly due to relatively higher availability of nutrients. Except for M22 site (summer voyage), the diatom abundance was higher in the Deep Chlorophyll Maximum Layer (DCML) than those in the surface layer (5 m) and the bottom of the euphotic layer (200 m) in summer and winter. The diatom export flux was between 10³-10⁵ cells m⁻² d⁻¹ and varied with the stations. By comparing the fluxes of pigment-containing diatoms (full cells) in 50 and 200 m traps of three sites (K2b, M22 and K8a), the flux at K2b was the largest, which implied that the diatoms at the K2b site contributed the most to the carbon sink in the sea area. The finding is may related to the Trichodesmium bloom occurred in K2b when the water was sampled. Our results give us a basic understanding of the diversity and potential roles of diatoms in NPSG and provide an important foundation for exploring application of iron fertilization in future to increase carbon export in NPSG.

Methods

Samples were collected using CTD and sediment trap. Taxonomic analysis of diatom species was based on microscope observation. Utermöhl method was used to quantitative analysis of diatoms vertical fluxes.

Results

Fig.1 Stations of two cruise in the North Pacific Subtropical Gyre (NPSG)

Fig.2 The distribution characteristics of diatom biomass in the NPSG (a) Summer cruise (b) Winter cruise

Fig.3 The comparison of diatom biomass in summer and winter (a) K2b station (b) M22 station (c) K8a station

Fig.4 The vertical export fluxes of diatoms during summer curise (a) K2b station (b) M22 station (c) K8a station

Empty diatoms show empty frustules and full diatoms show full frustules.

Fig.5 The proportion of different diatoms in the total flux (a) Empty Rhizosolenia (b) Mastogloia rostrata

Conclusion

1. The abundances of diatoms in the stations analyzed were between 20 - 2110 cells L⁻¹, being 1-3 orders of magnitude lower than that in coastal ocean.
2. The diatom export flux was between 10³-10⁵ cells m⁻² d⁻¹ and varied with the stations.
3. The diatom export flux: K2b>M22>K8a.

Acknowledgements: This work was supported by the National Natural Science Foundation of China (Grant No. 41890804).