

Biophysical Controls on Vertical Fluxes of Dissolved and Particulate Carbon, Nitrogen and Phosphorus in the Northern South China Sea

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Vertical fluxes of particulate organic matter and diffusion flux of dissolved organic matters (DOM) are the major part of biological pump in the ocean. In this study, we employed shipboard observations and sediment-trap deployments to collect water samples and sinking materials for hydrographic and chemical analyses in the northern South China Sea (NSCS). In addition to seasonal variability, effects of eddy and internal waves on vertical fluxes of carbon (C), nitrogen (N) and phosphorus (P) are also explored. Vertical fluxes of C, N and P in the NSCS were respectively estimated to be $66.8 \pm 1.29 \text{ mg C m}^{-2} \text{ d}^{-1}$, $12.8 \pm 0.38 \text{ mg N m}^{-2} \text{ d}^{-1}$ and $0.99 \pm 0.07 \text{ mg P m}^{-2} \text{ d}^{-1}$ in the spring season, about $64.3 \pm 1.47 \text{ mg C m}^{-2} \text{ d}^{-1}$, $12.1 \pm 0.47 \text{ mg N m}^{-2} \text{ d}^{-1}$ and $0.93 \pm 0.04 \text{ mg P m}^{-2} \text{ d}^{-1}$ in the summer season, and about $155 \pm 15.9 \text{ mg C m}^{-2} \text{ d}^{-1}$, $21.2 \pm 1.68 \text{ mg N m}^{-2} \text{ d}^{-1}$ and $1.79 \pm 0.19 \text{ mg P m}^{-2} \text{ d}^{-1}$ in an internal-waves induced event. Meanwhile, the organic carbon flux derived from the modified Vertical Generalized Production Model (VGPM) was $183 \pm 17 \text{ mg C m}^{-2} \text{ d}^{-1}$ in a winter anticyclonic eddy in NSCS. Positive correlations were significant between the chlorophyll inventory and DIN inventory, and also significant between vertical fluxes of CNP and DIN inventory in the euphotic zone. Thus, vertical fluxes of CNP were apparently driven by primary production that was determined by the availability of DIN. The diffusion flux of DOM increased generally with depth and was enhanced obviously in the internal-waves condition. The proportions of CNP vertical fluxes to the biological pump in NSCS are 66.5%, 74.3% and 71.3%, respectively, in regular spring, about $63.8 \pm 9.18\%$, $76.6 \pm 0.58\%$ and $75.1 \pm 2.02\%$, respectively, in regular summer, and about 62.1%, 73.5% and 64.7%, respectively, in an internal-waves induced event. The vertical flux accounts for the highest proportion of the biological pump. However, the proportion of DOM flux is insignificant in the biological pump.

Keywords: Vertical fluxes, Biological pump, Carbon, Nitrogen and Phosphorus, Northern South China Sea