Change in lower trophic level ecosystem and its complex mechanism in the North Pacific

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The principal aims of this study is to understand how primary and secondary producers response on the several potential nutrient supply processes associated with physical mechanisms such as atmospheric dynamics, vertical mixing and ocean current in the western North Pacific where is the most active biological drawdown area of sea surface $p\mathrm{CO}_2$ in the world. Here we present the latest three results:

1) Mechanism of spring bloom of major phytoplankton, diatoms in the Oyashio region

The pelagic Oyashio region, western North Pacific is one of the world’s richest fishing ground. Massive diatom blooms occur extensively every spring in this region, suggesting that these blooms could support high biological productivity in this region. For spring blooming of diatoms in this region, two processes; supply of sufficient nutrients (including N, P, Si and Fe) and seeding of active diatom cells have been recognized to be essential. We have elucidated mechanism of the spring diatom blooms in the Oyashio region, focusing on seeding and growth processes of blooming diatoms. We examined conditions of spring diatom blooms and population dynamics of key diatom species in this area by analysis of long-term monitoring data of physico-chemical parmaters and diatom communities along a transect known as the “A-line” in the Oyashio off the southeast coast of Hokkaido, Japan.

2) Seasonal variation in eukaryotic phytoplankton from surface to the abyssopelagic zone

Eukaryotic phytoplankton is also important primary producer. Recent molecular techniques have revealed highly diverse species, but little is known about their dynamics. We examined size-fractionated eukaryotic phytoplankton communities by a 18S rRNA gene sequencing analysis from surface to abyssopelagic zone throughout one year at St. S1 (30°N, 145°E). The spring bloom was triggered not only by autochtonous community but also by phytoplankton delivered from outside regions. The allochthonous phytoplankton included many coastal origin taxa, and would significantly contribute to the biological pump at St.S1. Furthermore, our results show the taxa which efficiently export to deep waters in addition to well-known taxa having the “ballasting effect” such as coccolithophores and diatoms. Of particular interest is Prasinophytes putative *Pseudoscourfieldia marina*, *Ostreococcus*, *Micromonas*, and *Bathycoccus*, which sank to the abyssopelagic zone when they bloomed. Our molecular survey unveiled that the previously-overlooked species would significantly contribute to the subtropical biogeochemical cycles.

3) Sinking velocities of particles in the subarctic and subtropical regions of the western North Pacific
Organic compounds produced by phytoplankton bloom settle into deeper layer as sinking particles. We have investigated the sinking velocities of particles to understand how biogeochemical cycle works after the production in the surface. Sinking particles were collected by drifting sediment traps at 100-200 m at two observation sites K2 (47°N, 160°E) and S1 and were fractionated in 5 ranges of sinking velocities between 5 and 1000 m d^{-1} using an elutriation system. The averaged sinking velocities (w_{POC}) calculated from the velocity distributions of POC were faster at S1. For S1 particles, a positive correlation was found between w_{POC} and $CaCO_3$ content. This indicates that particles containing large amounts of denser $CaCO_3$ sink faster than those containing large amounts of organic matter with low densities. Particles at K2, mainly composed of opal and organic matter, did not exhibit a clear relationship between w_{POC} and the denser opal. Instead, w_{POC} had a positive correlation with $\delta^{15}N$ of the sinking particles and was small (large) when the surface layer was stratified (well-mixed). These results implied that the upper water stability/mixing would influence the growth/fragmentation of aggregates as well as chemical composition of them, thereby affecting w_{POC}.