沈降粒子のアミノ酸の窒素同位体比から北西部北太平洋の表層窒素循環の季節変化を明らかにする
Seasonal variations in surface water nitrogen cycle in the western subarctic North Pacific revealed by nitrogen isotope ratios of amino acid from the settling particles

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The nitrogen isotopic composition ($\delta^{15}N$) of nutrients in the surface ocean transfer to the $\delta^{15}N$ of phytoplankton, settling particles, and eventually benthic sediment. The $\delta^{15}N$ of settling particles and sediment can therefore be used to trace the past nitrogenous nutrient environment. Previous observations have revealed that there is an inverse relationship between seasonal $\delta^{15}N$ and flux of settling particles. In winter at high latitudes, the settling particles have high $\delta^{15}N$ and low flux as compared with other seasons. In contrast, the surface water nitrate in winter has the lowest $\delta^{15}N$ in a year due to convective mixing. The winter settling particles should also have the lowest $\delta^{15}N$, if winter phytoplankton assimilates only nitrate. Previous studies pointed out three reasons why $\delta^{15}N$ of settling particles from autumn to winter increases despite the decrease in $\delta^{15}N$ of surface nitrate: (1) the increase in contribution of zooplankton, which have a $\delta^{15}N$ about 3 ‰higher than that of phytoplankton; (2) the contribution of old particles most degraded with isotope fractionation in a year; and (3) the winter phytoplankton assimilates not only nitrate but also ammonium, which has higher $\delta^{15}N$ than nitrate due to nitrification. In this study, to clarify the reason we applied the compound-specific stable isotope analysis of amino acid and a marine nitrogen isotope model. Sediment trap experiment was conducted at 1000 m depth at station K2 (47°N, 160°E) from June 2014 to July 2015. The bulk $\delta^{15}N$ was determined by a sensitivity-improved EA/IRMS. The $\delta^{15}N$ of glutamic acid and phenylalanine were determined by GC/C/IRMS. The bulk $\delta^{15}N$ show relatively low values around 2‰ from July to August and increases to 5‰ from September to June, which is a typical seasonal variation observed at high latitudes. Surprisingly, the apparent trophic positions of settling particles estimated from the $\delta^{15}N$ of glutamic acid and phenylalanine are 2.0±0.1 both in summer and winter. This is the first evidence that the winter high-$\delta^{15}N$ of settling particles does not reflect the increase in contribution of zooplankton. Our model result suggested that the winter high-$\delta^{15}N$ value of settling particles mainly reflects the winter high-$\delta^{15}N$ of ammonium due to nitrification, which was strongly supported by the nitrogen isotopic compositions of amino acids.

キーワード：海洋窒素循環、窒素同位体、海洋生態系モデル
Keywords: Marine nitrogen cycle, Nitrogen isotope, Marine ecosystem model

