Seasonal variations in the nitrogen isotopic composition of settling particles at station K2 in the western subarctic North Pacific

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Intensive observations using hydrographical cruises and moored sediment trap deployments during 2010 and 2012 at station K2 in the North Pacific western subarctic gyre (WSG) revealed seasonal changes in δ^{15}N of both suspended and settling particles. Suspended particles (SUS) were collected from depths between the surface and 200 m; settling particles by drifting sediment traps (DST; 100-200 m) and moored traps (MST; 200 and 500 m). All particles showed higher δ^{15}N values in winter and lower in summer, contrary to the expected by isotopic fractionation during phytoplankton nitrate consumption. We suggest that these observed isotopic patterns are due to ammonium consumption via light-controlled nitrification, which could induce variations in δ^{15}N(SUS) of 0.4-3.1 ‰in the euphotic zone (EZ). The δ^{15}N(SUS) signature was reflected by δ^{15}N(DST) despite modifications during biogenic transformation from suspended particles in the EZ. δ^{15}N enrichment (average: 3.6 ‰) and the increase in C:N ratio (by 1.6) in settling particles suggests year-round contributions of metabolites from herbivorous zooplankton as well as TEPs produced by diatoms. Accordingly, seasonal δ^{15}N(DST) variations of 2.4-7.0 ‰showed a significant correlation with primary productivity (PP) at K2. By applying the observed δ^{15}N(DST) vs. PP regression to δ^{15}N(MST) of 1.9-8.0 ‰, we constructed the first annual time-series of PP changes in the WSG. Moreover, the monthly export ratio at 500 m was calculated using both estimated PP and measured organic carbon fluxes. Results suggest a 1.6 to 1.8 times more efficient transport of photosynthetically-fixed carbon to the intermediate layers occurs in summer/autumn rather than winter/spring.

Keywords: nitrogen isotopes, suspended and settling particles, nitrogen recycling, biological pump

