Concentration dependent nitrogen isotope fractionation during ammonium uptake by phytoplankton in a highly eutrophic estuary and its application to determine the phytoplankton contribution to particulate organic matter

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For nitrogen isotope fractionation during ammonium uptake by phytoplankton field observations and lab cultures produced highly variable isotope effects, ($^{15}k/^{14}k$-1)x1000, ranging from 0 to -29. To reconcile this apparent inconsistency we analyzed suspended particulate matter (SPM) collected during an intense algal bloom in the highly eutrophic and, often, hypoxic Danshuei estuary, northern Taiwan, in July 2009. The observed $\delta^{15}N$ ranged from -8.6 ‰ to 0.2 ‰, and the $\delta^{15}N$ of coexisting ammonium from 4.6 to 11.9 ‰, yielding isotope effects between -4.7 and -16.4. The plot of all field observed isotope effects vs. corresponding ammonium concentrations shows a consistent trend, i.e., a concentration dependent curve, which shows a maximum magnitude of -20 at $[NH_4^+]$ ~100 uM with decreasing isotope effect on both sides [1]. Using this curve we determine the $\delta^{15}N$ of algal biomass from $\delta^{15}N_{NH4}$ and the isotope effect, which depends on $[NH_4^+]$. Employing a 3 end-member mixing model based on $\delta^{15}N$ and C/N, we found algal contribution to be 45% in February and 75% in July, suggesting phytodetritus as the major culprit that consumes oxygen during hypoxia.

[1] Liu, K.-K., et al. (2013) Concentration dependent nitrogen isotope fractionation during ammonium uptake by phytoplankton under an algal bloom condition, *Mar. Chem.* **157**, 242–252.