Isotope constraints on seasonal dynamics of dissolved and particulate N in the Pearl River Estuary, south China

FENG YE[1], LUHUA XIE[2], GANGJIAN WEI[2], GUODONG JIA[3*], JIE XU[4]

[1]MSG, Guangzhou Institute of Geochemistry, CAS, Guangzhou, 510640, China (yefeng@gig.ac.cn)
[2]SKLIG, Guangzhou Institute of Geochemistry, CAS, Guangzhou, 510640, China
[3]SKLMG, Tongji University, Shanghai, 200092, China (* correspondence: jiagd@gig.ac.cn)
[4]LTO, South China Sea Institute of Oceanology, CAS, Guangzhou, 510301, China

N and O isotope measurements were performed on suspended particulate matter and filtered water sampled along the salinity gradient of the Pearl River Estuary (PRE) to investigate the main N sources and its biogeochemical processing under the influence of monsoon climate. Our study revealed that domestic wastewaters and soil organic N are the major sources of DIN in freshwater during winter and summer respectively, whereas PN was dominated by phytoplankton biomass in both seasons. At low salinities (<5.0), nitrification represents a significant NO_3^- source but NH_4^+ sink, contributed 39.2±6.1% and 72.4±10.0% of NO_3^- to the estuary in summer and winter respectively (calculated from $\delta^{18}O_{NO3}$). An even larger contribution of nitrification to the NO_3^- pool in winter than in summer most likely resulted from the seasonal difference in the relative utilization of NH_4^+ and its relative importance to NO_3^- pool. At salinities of >5.0, the data identify that the intense sediment-water interaction and resuspension of sediments as important N cycling processes during winter when the estuary is well mixed. In contrast, mixing of freshwater and seawater plays a key role in determining the distribution patterns of NO_3^- and NH_4^+ in summer. Importantly, however, an intrinsic coupling between assimilation, remineralization and nitrification might be also occurring, as indicated by the similarity of summer $\delta^{15}N$ signals for NO_3^-, NH_4^+ and PN. At high salinities, the influence of assimilation tended to be most dominant in NO_3^- cycling. Moreover, the greater increase in $\delta^{18}O_{NO3}$ than in $\delta^{15}N_{NO3}$ (up to 15.6‰) in winter suggests that atmospheric deposition may exert a substantial influence on NO_3^- cycling processes. These results show the importance of seasonal variability in physical forcing on biological N sources and its turnover processes in large estuaries that impacted by anthropogenic activities, and have direct implications for budget the N fluxes exported to the ocean.