Vertical distribution and controls of nitrification in the upper ocean of northwestern Pacific

MIN XU[1], YANHUA WU[1], XIANHUI WAN[1], YANGYANG LU[1], SHUH-JI KAO[1]

[1] State Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen, China□sjkao@xmu.edu.cn

Nitrification is a key process transforming regenerated ammonia into nitrite, then further to nitrate. Nitrification process might generate N_2O, which feedbacks to climate. In spite of it importance, nitrification has long been considered insignificant in the surface water due to low ammonium affinity of ammonia-oxidizing bacteria (AOB) comparable to phytoplankton, as well as light inhibition. Until recently, researchers realized the wide distribution of ammonia-oxidizing archaea (AOA) in upper ocean and their remarkably high specific affinity. Furthermore, study indicated nitrification-induced nitrate may lead to 12%-32% overestimate of new production. In spite of the importance of nitrification available data is limited in upper ocean□in March 2014, we conducted survey for nitrification rate (labelled $^{15}NH_4^+$ addition) and ammonia-oxidizer abundance (AOA and AOB) in the upper ocean of northwestern Pacific. Nitrification rate ranged from 0.03 - 4.2nmolL-1d-1 throughout the upper water column (500m) and AOA was predominant nitrifier. In general, nitrification rate and AOA abundance peaked at around the bottom of euphotic layer. In upper layer, we observed a downward increasing tendency in nitrification rate that was attributable to light inhibition since ammonium concentration was not limiting. The correlation of nitrification rate against AOA abundance was better than nitrification rate against NH_4^+ concentration. At some depths, high nitrification rates accompanied well with AOA abundance but not with NH_4^+ concentration, strongly indicating that stationary phase was reached and high ammonium supply was required to sustain high nitrification at these specific layers. On the other hand, nitrite concentrations were higher in upper 100m revealing an opposite pattern to downward increasing nitrification. In conclusion, our results suggested that overestimation by nitrification should be considered while operationally-defined new production measurement is conducted and the upper ocean in situ N_2O production might exist as indicated by model projections.