Ammonium utilization by nitrifier and phytoplankton in photic zone at northwestern Pacific Ocean

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The recycling of ammonium in photic zone remains unclear due to its trace amount, rapid turnover and various utilization pathways. In northwest Pacific cruise during March to April 2014, we conducted incubation experiments by using the ^{15}N labeled ammonium to measure rates of nitrification and NH_4^+ uptake by phytoplankton of a high vertical resolution profile in the upper water column (150m) to examine the relative consumption rates by phytoplankton and nitrifier. Samples were incubated under in situ light intensity for 24 and 48 hours to examine their relative competitiveness over a diel cycle. At the same time, samples from 30m depth were selected to do the Michaelis-Menten incubation. Nutrients (NH_4^+, NO_2^-, NO_3^-), particular organic nitrogen (PN), amoA gene of AOA and AOB, nitrification rate and ammonium uptake rate were measured. The nitrate and ammonium ambient concentrations ranged 250 -1500 nM and 1-25 nM, respectively and AOA amoA gene predominates (by three orders higher than amoA gene copies). During incubation, the added $^{15}NH_4^+$ (30 nM) was up-taken mainly by phytoplankton (4 -12 nmole/L/d) in the first day; however, the uptake rate reduced significantly even stopped in some layers in the second day. By considering a continuous decrease in ammonium concentration through time during incubation, there is likely a threshold of ~30 nM for phytoplankton to uptake ammonium under nitrate sufficient conditions. In spite of decreasing substrate, by contrast, ammonium oxidation rates remained constant though relatively lower (0.2-3 nmole/L/d) throughout 48 hours incubation. Whether the ammonium threshold for phytoplankton uptake is nitrate-dependent remains unclear; yet, our results indicate that nitrifier (AOA mainly) outperform phytoplankton in sunlit ocean when ammonium is below the threshold.