Ammonium regeneration and nitrification rates in the oligotrophic Atlantic Ocean: Implications for new production estimates

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Limnol. Oceanogr., 53(1), 2008, 52-62 | DOI: 10.4319/lo.2008.53.1.0052

ABSTRACT: N regeneration was measured on a transect of the North and South Atlantic, from the United Kingdom to the Falkland Islands, that included extreme oligotrophic conditions. NH_4^+ and NO{2 oxidation rates were measured from the surface and base of the photic zone at 16 stations, using an isotope dilution technique in conjunction with gas chromatography/mass spectrometry analysis. NH_4^+ regeneration rates were 10-160 nmol L^{-1} d^{-1}, NH_4^+ oxidation was ~1-10 nmol L^{-1} d^{-1}, and NO_2^- oxidation was 1-30 nmol L^{-1} d^{-1}. Outside the oligotrophic central gyres, high rates of NH_4^+ regeneration were found in the northwest African upwelling region. In the central gyres, nitrification and NH_4^+ regeneration rates were sufficient to completely replace the dissolved inorganic nitrogen (DIN) pool within 1 d. These high turnover rates of the DIN pool indicate that both NH_4^+ regeneration and nitrification must be considered when estimating N assimilation rates by the ^{15}N technique. Even in incubations of short duration, N assimilation rates are likely to be underestimated and may introduce error in the estimation of the *F*-ratio. In the majority of experiments with near-surface samples, nitrification could replace the NO_3^- pool in less than 8 h, suggesting that a substantial majority of the NO_3^- pool in the surface oligotrophic Atlantic is derived from the regeneration of N. These findings increase the uncertainty of current new production estimates. The combined effect of the errors in estimating N-assimilation rates without determining N regeneration and the reclassification of NO_3^- as a regenerated N source in oligotrophic regions may question the accuracy of C export estimations based on *F*-ratios.

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