NITROGEN FIXATION RATES AND CONTROLS AT STATION ALOHA

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ABSTRACT

Temporal and depth variability in rates of dinitrogen (N_2) fixation at Stn. ALOHA, an oligotrophic site in the North Pacific Subtropical Gyre (NPSG), were assessed with direct measurements and using an isotope mass balance model based on the particulate nitrogen (PN) export flux during the period April 2004 – March 2005. Measured N_2 fixation rates and the implied large fraction of new production supported by diazotrophy emphasize the importance of N_2 fixation in nutrient dynamics in the NPSG. Nearly all (95%) N_2 fixation in the euphotic zone (0 – 125 m) occurred in the upper 75 m and was mostly supported (57 – 76%) by diazotrophs less than 10 μm in diameter. Over the year long period of observation, N_2 fixation varied with measured soluble reactive phosphorus (SRP) inventories and previously documented seasonality of iron (Fe) delivery to the North Pacific. High surface diazotroph activity was observed in July – August 2004 (1.63 – 1.68 μmol N m^{-3} d^{-1}) and low N_2 fixation rates occurred September – November 2004 (0.38 – 0.68 μmol N m^{-3} d^{-1}). The dependence of diazotrophy on available Fe and phosphorus (P) was further explored using manipulation experiments which resulted in enhanced N_2 fixation rates upon addition of Fe and/or P. Occasional Fe and/or P limitation on diazotroph activity may result in a net decrease in N_2 fixation at Stn. ALOHA. The potential decreasing contribution of N_2 fixation to new production in the NPSG is suggested by the observed increase in $\delta^{15}N$ of exported PN during July 2001 – November 2004.