Isotopic heterogeneity and cycling of organic nitrogen in the oligotrophic ocean

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ABSTRACT: We measured the nitrogen (N) isotopic composition ($\delta^{15}N$) of a large set (n = 38) of high-molecular-weight (HMW) dissolved organic nitrogen (DON) samples isolated from the tropical and subtropical North Atlantic and Pacific Oceans. The $\delta^{15}N$ signature of surface HMW DON is relatively invariable in both oligotrophic basins (4.1 ± 0.6‰ in the Atlantic; 5.4 ± 0.8‰ in the Pacific) and shows little correlation with sources or concentrations of N supporting new production in the euphotic zone. While large variations in $\delta^{15}N$ of bulk HMW DON are not apparent, $\delta^{15}N$ of proteins isolated from sites with relatively high rates of N_2 fixation (>80 μmol N m^{-2} d^{-1}) were consistently depleted in ^{15}N relative to bulk HMW DON and to proteins isolated from sites where N_2 fixation does not routinely occur. This small component of HMW DON appears to be cycling more rapidly than bulk HMW DON and may be indicative of fresh DON contributed by organisms in the surface ocean. Furthermore, $\delta^{15}N$ of DNA extracted from the bacterial size fraction (0.2-0.5 μm) revealed that free-living bacteria may be an important sink for isotopically depleted N produced during N_2 fixation. We suggest that there exists a tight coupling between the production and uptake of DON contributed by diazotrophs (N_2 fixers) in regions where N_2 fixation provides a major input of new nitrogen.