N isotope effects in the eastern Tropical North Pacific OMZ

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Marine Oxygen deficient zones (ODZs) host up to 50% of marine N_2 production, with the eastern tropical North Pacific (ETNP) being the largest oxygen deficient zone. We measured $\delta^{15}NO_3^-$, $\delta^{15}NO_2^-$, and $\delta^{15}N_2$ along a transect normal to the coast in the heart of the ODZ during 2012. The $\delta^{15}N$-N_2 minimum was 0.34‰ at 300m, which corresponded with the N_2/Ar maximum. After background atmospheric N_2 was removed, the biological $\delta^{15}N$-N_2 ranged from -7‰ to -22‰. The difference between $\delta^{15}N$-NO_3^- and $\delta^{15}NO_2^-$ was quite large in the ODZ because $\delta^{15}NO_3^-$ ranged from +15 to +24‰, while $\delta^{15}NO_2^-$ was generally between -11 and -18‰. The isotopic separation between nitrite and nitrogen gas ($\Delta^{15}N_{NO2-N2}$) changed sign from ~5‰ at the top of the oxygen deficient zone to ~-10‰ at 300m at the bottom, indicating an important shift in the system with depth. The closed system Rayleigh isotope effects (ε) for N_2 production from both the $\delta^{15}N$-DIN (ε_{DIN} =26±11‰) and $\delta^{15}N$-N_2 (ε_{N2}=27±6‰) was calculated for each individual depth. The ε_{DIN} and ε_{N2} matched closely and both ε depth profiles showed maximal fractionation at 300m. Similar calculations were also done for one offshore station from the Arabian Sea in 2007 using $\delta^{15}N$-N_2 (ε_{N2}=24±4‰) and two offshore stations from the Eastern Tropical South Pacific in 2005 using $\delta^{15}N$-N_2 (ε_{N2}=23±6‰) and $\delta^{15}N$-DIN (ε_{DIN}=22±7‰). The relatively large fractionation factors for N_2 production appear to be ubiquitous in all three major offshore oxygen deficient zones, which has implications for the balance of the N budget.