Hypoxic events stimulate nitrogen recycling in a shallow salt-wedge estuary: The Yarra River estuary, Australia

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ABSTRACT: The Yarra River estuary is a salt-wedge estuary prone to periods of stratification-induced anoxia and hypoxia (O_2 < 100 µmol L^{-1}) during low-flow events. Nitrate reduction pathways were examined using the ^{15}N isotope pairing technique in intact sediment cores, emulating in situ conditions, to evaluate the fate of NO during changing oxygen conditions. Water-column concentrations of dissolved inorganic carbon (DIC), O_2, NH, and NO_x (NO + NO) were also measured to examine any deviation from conservative behavior (denoted Δ) in response to oxygen variability within the estuary. The estuary was a source of NH in the anoxic bottom waters. Whole-system estimates using deviations from conservative behavior and core incubations were in good agreement and showed that NH was regenerated more efficiently relative to DIC under hypoxic conditions. For the whole system, mean ΔDIC : ΔNH ratios under oxic (85 ± 33) and hypoxic (20 ± 3) conditions were significantly different. The more-efficient NH regeneration during hypoxia was attributed to rapid mineralization rates and cessation of nitrification; dissimilatory nitrate reduction to ammonium (DNRA) was not a significant contributor. Unexpectedly, the denitrification : DNRA ratio was significantly higher under hypoxic conditions, with denitrification contributing 99.1% ± 0.3% of total nitrate reduction. DNRA rates were significantly higher during oxic conditions (123.5 ± 30.7 µmol m^{-2} h^{-1}) when compared with rates during hypoxia (0.6 ± 0.1 µmol m^{-2} h^{-1}). The increase in DNRA in the presence of oxygen was attributed to the alleviation of NO limitation during these conditions.

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