Anammox and denitrification in the oxygen minimum zone of the eastern South Pacific

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ABSTRACT: We quantified the removal of fixed nitrogen as N_2 production by anammox and N_2 anc N_2O production by denitrification over a distance of 1900 km along the coasts of Chile and Peru, using short-term incubations with ^{15}N-labeled substrates. The eastern South Pacific contains an oxygen minimum zone (OMZ) characterized by an anoxic, nitrate- and nitrite-rich layer of ~ 200 thickness below 30 – 90 m of oxic water. Anammox and denitrification were almost exclusively recorded when the in situ O_2 concentration was below detection, indicating that the induction of these processes is highly oxygen sensitive. Anammox was detected in 70% of the samples from anoxic depths. Denitrification was detected in fewer samples, but maximum rates were an order of magnitude higher than those of anammox. In our incubations denitrification was responsible f 72% of the total N_2 production and 77% of the total removal of fixed nitrogen including N_2O production. However, at the individual depths it could be one or the other process that was responsible for all of the nitrogen removal. Anammox activity was highest just below the oxic – anoxic interface and declined exponentially with depth, whereas no depth dependence was discerned for denitrification. Denitrification resulted in net production of N_2O in some of the samples and consumption of added $^{15}N_2O$ in others. Together with the accumulation of this indicates that denitrification must be seen as a sequence of individually regulated reactions, ea of which may start and stop depending on the electron donor input, while anammox is much les variable. The highly patchy distribution of denitrification contributes to explain the apparent imbalances between ammonium sources and sinks suggested by previous ^{15}N-based studies in OMZs.