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High resolution depth profiles of anammox and denitrification in the OMZ off northern Chile

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N2 production by anaerobic ammonium oxidation (anammox) and denitrification in oceanic oxygen minimum zones (OMZ's) are important sinks in the marine nitrogen cycle, but the distribution and regulation of these processes in OMZ's is poorly understood because most previous studies have limited their measurements to few stations and few depths per station. We used 15N-labeled compounds to measure the distribution of anammox and denitrification at a resolution of 5 to 10 m across the oxycline and into the core of the OMZ off northern Chile at two stations characterized by high and low surface chlorophyll levels, respectively. Anammox rates were consistently higher than denitrification rates, and rates at the high-chlorophyll station were twice those at the low-chlorophyll station. Dissimilatory nitrite reduction to ammonium (DNRA) was not detected.

The distribution of the processes relative to oxygen was investigated using STOX O2 sensors with a detection limit of $\sim$0.01 μM. Denitrification was only detected below in situ oxygen concentrations of 0.3 μM and rates increased steadily with depth into the OMZ core where oxygen was not detectable. Also anammox rates increased sharply once in situ O2 concentrations dropped below 0.3 μM and peaked in the upper part of the OMZ core.

Our results demonstrate that N2 production in the OMZ is restricted to oxygen concentrations well below the thresholds of 5 – 20 μM, which are typically used to delimit OMZ waters.