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TITLE: Aerobic ammonium oxidation in the oxycline and oxygen minimum zone of the eastern tropical South Pacific off northern Chile (20°S)

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ABSTRACT:

Aerobic NH_4^+ oxidation rates were measured along the strong oxygen gradient associated with the oxygen minimum zone (OMZ) of the eastern tropical South Pacific off northern Chile (20°S) during 2000, 2003, and 2004. This process was examined by comparing NH_4^+ rates of change during dark incubations, with and without the addition of allylthiourea, a classical inhibitor of the ammonia monooxygenase enzyme of ammonium-oxidizing bacteria. The contribution of aerobic NH_4^+ oxidation in dark carbon fixation and NO_2^- rates of change were also explored. Thirteen samples were retrieved from the oxycline (252 to 25 $\mu\text{M O}_2$; 15 to 65 m depth) and three from the oxygen minimum core (25 $\mu\text{M O}_2$; 100–200 m depth). Aerobic NH_4^+ oxidation rates were mainly detected in the upper part (15–30 m depth) of the oxycline, with rates ranging from 0.16 to 0.79 $\mu\text{M d}^{-1}$, but not towards the oxycline base (40–65 m depth). In the oxygen minimum core, aerobic NH_4^+ oxidation was in the upper range and higher than in the upper part of the oxycline (0.70 and 1.0 $\mu\text{M d}^{-1}$). Carbon fixation rates through aerobic NH_4^+ oxidation ranged from 0.18 to 0.43 $\mu\text{g C L}^{-1} \text{d}^{-1}$ and contributed between 33% and 57% of the total dark carbon fixation, mainly towards the oxycline base and, in a single experiment, in the upper part of the oxycline. NO_2^- consumption was high (up to 10 $\mu\text{M d}^{-1}$) towards the oxycline base and OMZ core, but was significantly reduced in experiments amended with allylthiourea, indicating that aerobic NH_4^+ oxidation could contribute between 8% and 76% of NO_2^- production, which in turn could be available for denitrifiers. Overall, these results support the important role of aerobic NH_4^+ oxidizers in the nitrogen and carbon cycling in the OMZ and at its upper boundary.

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