



Anoxic nitrification: new pathways for nitrogen removal in dynamic near-shore sediments

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The anoxic oxidation of ammonia by manganese oxides is a newly recognised pathway for the production of nitrate, and ultimately dinitrogen, in marine sediments, potentially contributing a significant loss of nitrogen from the world's oceans. The significance of this 'anoxic nitrification' is poorly constrained; while it was previously thought that anoxic nitrification be restricted to manganese rich environments, our work offers new evidence from near shore sediments of Loch Fyne (NW Scotland) and the Humber Estuary (UK), which suggests that sediment disturbance and manganese cycling effect a major control on this biologically mediated process. A combination of sediment cores and laboratory mesocosm experiments showed anoxic accumulation of nitrate, nitrite and dinitrogen gas under anoxia, with and without the addition of manganese oxides to the experiments. The anoxic nitrification reaction significantly depleted ammonia, and occurred simultaneously with manganese, iron and sulfate reduction, and methanogenesis. Sediment disturbance appeared to increase the likelihood of anoxic nitrification, suggesting that the physical dynamics of near shore environments are important for nitrogen cycling, and explaining variability in anoxic nitrification across studied sites.