Denitrification and sulfate reduction in Arctic continental margin sediments

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We have determined sedimentary pore-water nitrate profiles as well as sulfate reduction reduction rates for several cross-margin transects in the eastern Chukchi sea (U.S. Arctic) during Summer 2002 (July-August) and Spring 2004 (May-June). In general, nitrate penetration depths were less than 1 cm for stations shallower than about 200 m but penetration depths increased dramatically as overlying water depth increased. At some of the deepest stations nitrate was present thoughout the entire sampling depth (upper 20 cm). There were also significant differences both spatially and temporally. Nitrate penetration generally decreased from west to east and from summer to spring. Nitrate fluxes were calculated from the profiles and varied from about 0.5 to about 0.05 mMoles/m2/d with patterns in rate being inversely correlated with penetration depth. Sulfate reduction rates varied between 2.1 and 0.01 mMoles/m2/d per day; they also decreased with increasing water depth and showed temporal variability. The magnitudes of nitrate reduction rate and sulfate reduction rate as well as their patterns with depth were similar to those those along the productive U.S. west coast for stations near Barrow Canyon (eastern stations) while rates at stations stations west of Barrow Canyon were much lower. The relatively high rates near Barrow Canyon may be due to off-shelf transport of organic matter through the Canyon.

Quantifying the role of manganese in biotic and abiotic nitrogen cycling

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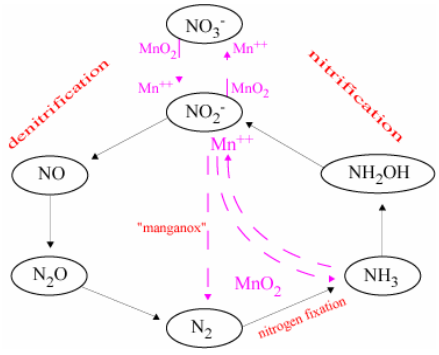
Motivation

Controversy exists as to the (thermodynamically feasible) role of reduced and oxidized phases of manganese in nitrogen cycling in marine sediments.



Potential roles for Mn++ and MnO2 in the marine nitrogen cycle examined in this study.

Methodology

We investigated the role of manganese in the nitrogen cycle in the Gulf of Mexico. Using an array of innoculations with isotopically-labelled nitrogenous compounds, we examined the role of Mn^{++} as an electron donor in the reduction of NO_3^-, and the role of MnO_2 as an electron acceptor in the oxidation of both NO_2^- and NH_4^+. Our experiments were specifically designed to distinguish between biotic and abiotic reactions, by using 'live' and 'dead' innoculations in parallel.

Results and Conclusions

Our results suggest a definitive but limited role for MnO_2 and Mn^{++} in both biotic and abiotic nitrogen cycling. Abiotic reactions, where experimentally detected, are generally an order of magnitude slower than their biologically-mediated equivalents.