ENVIRONMENTAL SCIENCES 275 SEMINAR

INTRICATE COUPLING OF CARBON, NITROGEN AND IRON REDOX CYCLING UNDERLYING THE BIOGEOCHEMICAL DYNAMICS OF N_2O

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103 Materials Science & Engineering Building

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Over century long timescales, the climatic forcing of nitrous oxide (N_2O) dwarfs that of carbon dioxide. Although increasing atmospheric levels are linked to excess nitrogen loading and consequent formation via microbially mediated pathways, factors regulating the emission of N_2O to the atmosphere remain difficult to predict and the global N_2O budget remains poorly constrained. In large part, these challenges stem from the fact that a diverse number of N_2O production pathways may be at work, especially in environments hosting dynamic redox conditions - and thus disentangling their relative roles in regulating N_2O is challenging. As coastal ecosystems are especially subject to elevated nitrogen loading, we have been focusing investigations on better understanding the controls on N_2O production mechanisms in intertidal sediments using a variety of novel isotopic approaches. Surprisingly, initial findings have indicated that under elevated nitrate loading, increased emissions of N_2O are not mediated by direct bacterial activity, but instead appear to be largely catalyzed by fungal denitrification and/or abiotic reaction with reduced iron (chemodenitrification).

Expanding on these findings, results from lab experiments focused on non-traditional production pathways demonstrate high potential for cryptic cycling processes under dynamic redox oscillations and shed some new light on factors controlling kinetics, yields, and isotopic composition of product N_2O. As both fungal and chemodenitrification typically exhibit N_2O yields far greater than bacterial production, even small levels of their activity could produce disproportionately large amounts of N_2O, suggesting the possibility of their potentially substantial, yet widely overlooked, role especially in coastal ecosystem N_2O fluxes. Finally, these findings may help to explain the notoriously high variability of environmental N_2O fluxes, which may in part be driven by spatial and temporal heterogeneity in organic matter respiration by fungi and the redox cycling of iron.

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