

SULFUR GAS EXCHANGE IN *SPHAGNUM*-DOMINATED WETLANDS 181357

Mark E. Hines, William Z. de Mello and Carolyn A. Porter
Institute for the Study of Earth, Oceans and Space
University of New Hampshire
Durham, New Hampshire 03824

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Sulfur gases are important components of the global cycle of S. They contribute to the acidity of precipitation and they influence global radiation balance and climate. The role of terrestrial sources of biogenic S and their effect on atmospheric chemistry remain as major unanswered questions in our understanding of the natural S cycle. We have been investigating the role of northern wetlands as sources and sinks of gaseous S by measuring rates of S gas exchange as a function of season, hydrologic conditions and gradients in trophic status. We have also investigated the effects of inorganic S input on the production and emission of gaseous S.

Experiments have been conducted in wetlands in New Hampshire, particularly a poor fen, fens within the Experimental Lakes Area (ELA) in Ontario, Canada and in freshwater and marine tundra. Emissions were determined using Teflon enclosures, gas cryotrapping methods and gas chromatography (GC) with flame photometric detection. Dynamic (sweep flow) and static enclosures were employed. Dissolved gases were determined by gas stripping followed by GC.

Emissions of dimethyl sulfide (DMS) greatly dominated S gas fluxes from all sites. In New Hampshire, DMS fluxes were $>1.6 \mu\text{mol m}^{-2} \text{h}^{-1}$ in early summer, 1989 which were several-fold faster than average oceanic rates of DMS emission. After construction of a dam by a beaver in 1990, DMS fluxes decreased for the next two years to $\sim 150 \text{ nmol m}^{-2} \text{h}^{-1}$. Fluxes displayed a smooth diel pattern which followed temperature. Dissolved DMS and methyl mercaptan (MSH) concentrations varied throughout the fen both temporally and spatially. Concentrations were highest in the most minerotrophic areas and in the spring.

Additions of SO_4^{2-} caused a rapid increase in dissolved DMS and MSH concentrations in pore waters. However, emissions of gases were not affected. Dissolved S gases were 100-fold higher in a site in which vegetation was removed. Conversely, emissions of DMS were higher in the vegetated sites. Although dissolved MSH concentrations increased in response to SO_4^{2-} additions, MSH efflux did not occur. The results suggested that DMS and MSH were formed from the methylation of sulfide.

S gas emissions in a Canadian wetland varied greatly along a transect running from the central pond to the upland. Emissions of S gases were slow in the floating *Sphagnum* mat next to the pond and were dominated by hydrogen sulfide (H_2S). Fluxes a few meters away from the pond were much higher and restricted to DMS, whereas sites adjacent to the upland exhibited low to undetectable fluxes of all S gases. Emissions from the lake surface were insignificant.

Carbonyl sulfide (COS) was consumed by *Sphagnum* wetlands in both the light and dark. However, when *Sphagnum* was removed, COS was emitted to the atmosphere. Dissolved COS concentrations varied from <0.1 to 10 nM and were highest in the summer and in minerotrophic areas.

Emissions of S gases (DMS) from these wetlands were much faster than expected from the low S content of the ecosystem. *Sphagnum* appeared to greatly enhance S gas flux compared to other types of vegetation, and fluxes were often highest in ombrotrophic regions. Fluxes calculated from S gas concentrations in standing water pools or in pore waters will often greatly underestimate rates compared to direct measurements using chambers. Emissions of S gases from northern wetlands probably do not contribute greatly to the global burden of atmospheric S. However, they may affect regional budgets. More importantly, investigations of controls on these relatively rapid fluxes may be useful for understanding S cycling in northern, continental areas.