



Isotope fractionations factors of N₂O production and reduction by denitrification: a. Laboratory incubation studies using N₂O reductase inhibition

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Isotopologue signatures of N₂O such as $\delta^{18}\text{O}$, average $\delta^{15}\text{N}$ ($\delta^{15}\text{N}^{bulk}$) and ^{15}N site preference (SP = difference in $\delta^{15}\text{N}$ between the central and peripheral N positions of the asymmetric N₂O molecule) can be used to constrain the atmospheric N₂O budget and to characterize N₂O turnover processes. However, the use of this approach to study N₂O dynamics in soils requires knowledge of isotopologue fractionation factors (ϵ) for the various partial processes involved, e.g. N₂O production by nitrification or denitrification, and N₂O reduction by denitrification.

Here we present results from laboratory incubations of soils and aquifer material to determine ϵ_{gf} N₂O production (ϵ_{prod}) and N₂O reduction to N₂ (ϵ_{red}) during denitrification. ϵ_{prod} for $\delta^{18}\text{O}$, $\delta^{15}\text{N}^{bulk}$ and SP was obtained by anaerobic incubation of NO₃⁻ amended soils when N₂O reduction was inhibited by 10 kPa acetylene. ϵ_{red} of the respective signatures was derived by comparing treatments with and without inhibition of N₂O reduction. We investigated samples from 4 mineral soils, one organic soil and from a sandy aquifer. The mineral soils were incubated under unsaturated conditions in closed or open systems, the organic and aquifer samples as homogenized slurries in a closed system.

Results of fractionation factors, process rates and incubation conditions will be presented and discussed in view of previous studies and theoretical considerations.