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Isotope fractionations factors of N_2O production and reduction by denitrification: a. Laboratory incubation studies using N_2O reductase inhibition

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Isotopologue signatures of N_2O such as $\delta^{18}O$, average $\delta^{15}N$ ($\delta^{15}N^{bulk}$) and ^{15}N site preference (SP = difference in $\delta^{15}N$ between the central and peripheral N positions of the asymmetric N_2O molecule) can be used to constrain the atmospheric N_2O budget and to characterize N_2O turnover processes. However, the use of this approach to study N_2O dynamics in soils requires knowledge of isotopologue fractionation factors (ε) for the various partial processes involved, e.g. N_2O production by nitrification or denitrification, and N_2O reduction by denitrification.

Here we present results from laboratory incubations of soils and aquifer material to determine εgf N_2O production (ε_{prod}) and N_2O reduction to N_2 (ε_{red}) during denitrification. ε_{prod} for $\delta^{18}O$, $\delta^{15}N^{bulk}$ and SP was obtained by anaerobic incubation of NO_3^- amended soils when N_2O reduction was inhibited by 10 kPa acetylene. ε_{red} of the respective signatures was derived by comparing treatments with and without inhibition of N_2O 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.