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Stable isotope measurements to uncover the mechanisms of nitrous oxide production and consumption in groundwater in a forested ecosystem

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Key word: Nitrogen and oxygen isotopes, nitrous oxide (N₂O), nitrification, denitrification, forest groundwater

A significant amount of nitrous oxide (N₂O), a greenhouse gas, is developed in a forested ecosystem. It has been regarded that mechanisms which could contribute to the N₂O budget in a forest ecosystem are presumably complex, as various pathways responsible for producing as well as consuming N₂O have been elucidated. We have conducted a series of field surveys on N₂O production and consumption in groundwater in the temperate forest catchment area near Kyoto, Japan by analyzing various parameters such as; N₂O concentration, N and O isotope natural abundances (δ¹⁵N and δ¹⁸O) of NO₃⁻ and N₂O, ¹⁵N site preferences in N₂O, potential denitrification activity. It is notable that, among these analyses of the parameters, stable isotope based techniques provided definite evidences for comprehensive understanding on mechanisms responsible for production and consumption of N₂O as well as its budget on this model site. Therefore, tracer techniques localized strata in which significant denitrification activity resides, and determining natural abundances of stable isotopes of N and O in various substances in denitrification pathway and site preference of ¹⁵N in N₂O molecule strongly suggested that N₂O was produced by nitrification, followed by N₂O reduction to N₂ in the groundwater.

S03-4
Ecological roles of thaumarchaea in acidic forest soils

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Despite the importance of enhanced nitrification along with N-saturation and soil acidification after high atmospheric N depositions in forests, microbial groups mainly responsible for the nitrification in such acidified forest soils is largely unknown. The purpose of this study is to elucidate the contribution of NH₃-oxidizing thaumarchaea and bacteria, and heterotrophic microbes to nitrification in highly acidic soils in southern China, all of which has been receiving high atmospheric N depositions. Combined analyses of ammonia monooxygenase subunit A (AmoA) gene transcript and gross nitrification rates revealed that the contribution of heterotrophic nitrifier and NH₃-oxidizing bacteria is generally low and that thaumarchaea dominate the NH₃ oxidation and even regulate the nitrification rates. Comparison with previous studies suggested that high nitrification activity of thaumarchaea in acidified soils could be due to their physiological properties that allow adapting substrate-limiting condition. The role of NH₃-oxidizing thaumarchaea was most highlighted in the highly acidified soils of N-saturated forest, in which highest rates of nitrification and subsequent nitrate leaching were observed. The present study suggested that thaumarchaea played leading roles in N dynamics through regulating NH₃ oxidation in highly acidic forest soils.