Tracing Atmospherically Deposited Nitrate in Forest Ecosystem Using Triple Nitrate Isotopes

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Nitrogen saturation is one of the forest environmental issues as a result of increasing anthropogenic emission of reactive nitrogen. Forest which reached nitrogen saturation exports residual nitrogen as dissolved inorganic nitrogen (mainly nitrate: NO_3^-) and the amount of NO_3^- leaching is one of the signal of nitrogen saturation. However, the mechanism of nitrate export from forest ecosystem is not well understood because of complexity of forest internal nitrogen cycle. In fact, NO_3^- has two sources, atmospherically deposited nitrate ($NO_{3\ atm}^-$) and microbial nitrate ($NO_{3\ microb}^-$) in forest ecosystem. These two sources could not be separated so far, but triple nitrate isotope analysis techniques enabled distinguishing $NO_{3\ atm}^-$ from $NO_{3\ microb}^-$, and revealed that the fraction of $NO_{3\ atm}^-$ (f_{atm}) in stream water is about 10% worldwide. To clarify the mechanism of export of atmospherically deposited nitrate ($NO_{3\ atm}^-$) to stream from forest catchment, we explored which factors of forest ecosystem influence f_{atm} in stream water.
We measured $\delta^{15}N\text{-}NO_3^-$, $\delta^{18}O\text{-}NO_3^-$, $\Delta^{17}O\text{-}NO_3^-$, and NO_3^- concentration along with forest hydrological pathways, through fall, soil water, ground water and stream water at Kiryu Experimental Watersheds (KEW) in central Japan.
We calculated the value of f_{atm} of four stream water, and mean value was about 10% except for one of the stream water which flows steep slope catchment. These results are consistent with the reports for stream. In soil, the concentration of NO_3^- and the values of f_{atm} were decreased along with the soil depth suggesting that $NO_{3\ atm}^-$ was consumed immediately at surface soil. In contrast, the values of f_{atm} were not fluctuated in ground water which suggests that the value of f_{atm} in stream water is almost determined at soil.

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