

Nitrogen cycling analysis of cedar plantations, using nitrate isotope ratios

Yoshifumi Tobari[1]; Keisuke Koba[2]; Keitaro Fukushima[3]; Naoko Tokuchi[4]; Nozomi Suzuki[5]; Sakae Toyoda[6]; Naohiro Yoshida[7]

[1] none; [2] Environ Sci and Tech, Tokyo Institute of Tech; [3] Forest Sci., Kyoto Univ.; [4] FSERC., Kyoto Univ.; [5] Environ. Chem. and Engr, Tokyo Tech.; [6] Environmental Chemistry and Engineering, Tokyo Tech; [7] IGSSE, Tokyo Institute of Technology

Recent years nitrogen input to forest has been increased by industrial development and increase use of fossil fuel, so elucidating the fate of nitrate added to forest ecosystems is quite important issue for revealing its potential of nitrogen-removing from environment, and better management of forests. Forest ecosystems in mountains region, typically in Japan, vary in many respects from Europe or United States, therefore, It is not possible to make the research result of Europe and America simply adjust to Japan as it is. In this study, measurement of nitrogen and oxygen isotopic ratios of nitrate give us integrated information of nitrate dynamics in Japanese forest ecosystems.

There are cedar/cypress plantations in Japan, about 40 percent of the total forest area is, need to maintain, therefore forest disturbance by human activity (e.g. clearcutting or thinning) is large proportion of total forest ecosystems. Forest disturbance is considered to affect nitrate discharge in many ways (Aber et al. 1998), and contribution of atmospheric nitrate to total nitrate discharge is dramatically increased after disturbance (e.g. forest decline by acid rain: Durka et al. 1994). In our study site with different application (logging) history, nitrate concentrations in streamwater showed clear trend.

Atmospheric nitrate has high oxygen isotope ratio (over 10 per-mill vs. VSMOW), while its nitrogen isotopic ratio is about 0 per-mill vs. Atmosphere N₂ and nitrate undergone denitrification in soil has high nitrogen isotope ratio (Kendall 1998). Nitrate discharge from forest ecosystems is mainly regulated by plant/microbe uptake, nitrification (NH₄ to NO₃) and denitrification (NO₃ to N₂).

If clear cut of plantation affects the ratio of atmospheric versus microbial (nitrified) nitrate in streamwater, together with high concentrations in younger forest, we can assume several signal of isotopic ratios of nitrate with the hypothesis below;

- 1) Streamwater from young forests has high oxygen isotope ratio resemble to that of rain.
- 2) Streamwater from aged forests has rather lower oxygen isotope ratio than young.
- 3) Nitrogen isotope ratio is affected by many parameter, groundwater level, angle of dip, watershed area, soil composition, and so on.

In this study site, we can comparable of the difference of the nitrogen circulation when year after re-foretasting is assumed to be the main parameter under almost the same environmental condition. Therefore, it is thought that year is an element that rules the nitrogen circulation if a significant difference is seen on this site compared with the nitrate isotope ratios.

In this research, it is assumed to be a purpose to analyze how the nitrogen circulation in the forest ecosystem is characterized by 100-year-timescale. We inspect this hypothesis and make first step of forest assessment by nitrate stable isotope ratios.