Using triple nitrate isotopes to determine nitrate sources in the streamwater of tropical dry forest

*Naoyuki Yamashita[1], Kazuaki Sumi[3], Midori Yano[3], Akiko Makabe[4], Keisuke Koba[3], Bopit Kietvuttinon[5], Hathairatana Garivait[6], Thiti Visaratana[5], Hiroyuki Sase[2]

1. Forestry and Forest Products Research Institute, 2. Asia center for air pollution research, 3. Kyoto University, 4. Japan Agency for Marine-Earth Science and Technology, 5. Royal Forest Department, 6. Environmental Research Training Center

In southeast Asia a nitrogen emission and deposition increased since 1980s. This could lead to the nutrient imbalances and the degradation of stream-water quality in tropical rain/dry forest which is largely distributed in the area. Quantifying the contribution of atmospheric nitrogen deposition to nitrogen discharge has not been well examined in tropical forest area. Oxygen isotope anomaly ($\Delta^{17}O$) would be a good technique for distinguishing the atmospheric nitrate from the microbe-oriented nitrate. Using this technique, existing studies has determined the fraction of atmospheric nitrate in the stream water mainly in temperate forest located in mid-latitude. However, an applicability of this technique is largely unknown in tropical area. Our objectives of the study are 1) to examine the applicability of $\Delta^{17}O$ techniques in tropical forest and 2) to clarify the contribution of the atmospheric nitrate to the stream water nitrate in the forest established in tropical savanna climate.

The study catchment was established in dry evergreen forest of the Sakaerat silvicultural research center, Nakohn Ratchasima Province in northeastern Thailand (35 ha). The altitude of the study catchment ranges 600 to 680 m. Annual mean precipitation was 1370 mm and annual mean temperature was 25.5 ° C. Climate type was tropical savanna. The period between November and March is extremely dry, with monthly precipitation less than 50 mm. Using bulk sampler, we collected a precipitation in the morning of the day just after the rain event was observed. We mixed the daily precipitation into the monthly composite samples and stored it at freezer. Meanwhile, nitrate in soil water and stream water was collected by anion exchange resin method. The resins for soil water and stream water were put during ca. 6 month and 2 weeks, respectively. We extracted the nitrate from the recovered resins from the field after the period. We measured nitrate concentration and isotopic compositions of the nitrate for each water and extracts samples. $\delta^{15}N$ and $\delta^{18}O$ of nitrate were determined by the denitrifier method. And $\Delta^{17}O$ was measured in Washington University after we transformed nitrate of the sampler to nitrous oxide by the denitrifier method.

As a result, in precipitation $\Delta^{17}O$ -NO_3^- in precipitation was about 21‰ and did not largely fluctuate during wet season. In soil water $\Delta^{17}O$-NO_3^- was 1.3 and 1.4‰ at surface and sub soil, respectively, on the slope. These values decreased on riparian area. This tendency simply suggested that the contribution of atmospheric nitrate steeply declined in soil water in this study catchment. As for the seasonality, $\Delta^{17}O$-NO_3^- of soil water was higher in dry season compared to wet season. Finally, $\Delta^{17}O$-NO_3^- in the stream water ranged 6 to 12‰ during wet season. We also found the significantly relationship between $\delta^{15}N$ and $\delta^{18}O$ in the stream water, which suggested the strong contribution of the denitrifying processes within the study catchment.

We assumed that this technique was effective for distinguishing the atmospheric nitrate from microbe-oriented nitrate even in the tropical forest ecosystems. Meanwhile, in this study $\Delta^{17}O$-NO_3^- of precipitation (21‰) was relatively lower than the value in existing report at mid-latitude. In this

presentation we are going to discuss the fraction of atmospheric nitrate to surface water nitrate by a quantitative approach.

Keywords: Oxygen isotope anomaly, Tropical dry forest, Nitrogen deposition

