Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

MIS006-08 Room: Exibition hall 7 subroom 3 Time: May 26 15:45-16:00

Partition stream water nitrate sources in a nitrogen-saturated tropical forest in southern China, using nitrate isotope

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Abstract: The fate of atmospheric nitrogen (N) inputs is increasingly concerned. A large fraction of anthropogenic N is likely leached out from forest ecosystems when N inputs exceed the biotic demand for N. In this study, we measured stable N and O natural abundance of nitrate (NO3-) in precipitation and streamwater to separate stream leached NO3- sources (atmospheric or microbial -produced) in a tropical forest in southern China. The study forest is > 400 years old, and N leaching is greater than atmospheric N input due to long-term N accumulation and high atmospheric N input in the last two decades. We initially expected that a large fraction of atmospheric NO3- would appear in stream immediately following the rain events. Our results showed that streamwater NO3- concentration increased rapidly when rainy seasons began, reaching 500 micromol L-1, and then decreased to, on average, about 150 micromol L-1 in dry seasons. The 15N abundace of NO3- was obviously higher in rainwater than in streamwater for most of the sampling occasions, but both overlapped with that in soil NO3-). The 18O abundance of NO3- varied largely from 26.8-83.5 per mil (on average 60.1) in rainwater, but kept relatively constant (7.0-15.4 per mil, averaged 9.7) in streamwater although with slightly higher values in dry seasons. Two-end member calculation using 3.8 per mil as the 18O abudance of soil NO3- (K. Koba data) showed that on average 11 percent (from 4 to 31) of stream NO3- was of atmospheric origin over the study period. This estimate of atmospherically derived NO3- in streamwater is similar to that reported for N-limited temperate forests. This result indicates that atmospheric N is efficiently processed or recycled even in N-saturated tropical forest with high and frequent precipitation.

Keywords: atmospheric deposition, nitrate isotopes, nitrogen saturation, streamwater, tropical forest