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Spatial and temporal heterogeneity of the sources of streamwater sulfate in tropical dry forest catchment in Thailand

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In Southeast Asia an increase in emissions of sulfur (S) into the atmosphere may introduce new risks for the plant, soil and inland-water through acidification. However, the effect of the atmospheric S deposition on acidification by an increase in sulfate is poorly understood in tropical forests with possible S sources and processes in the internal cycle. S isotopic ratio (δ^{34}S) could be a good indicator to identify the source of sulfate in soil and inland-water because only dissimilatory S reduction results in a large fractionation of S isotope. Our objectives are to clarify the spatial and temporal variability of δ^{34}S in rainfall, throughfall, soil and stream water within the catchment and discuss the influence of the atmospheric S input on the stream in tropical forest.

Study catchment has been established at dry evergreen forest in Sakaerat silvicultural research station, northeastern Thailand. Anion-exchange-resin columns were installed for rainfall, throughfall, soil-water and stream-water through a year to collect and concentrate sulfate in the field. The sulfate retained in the resin was extracted by NaCl and precipitated as $BaSO_4$. We determined ^{34}S / ^{32}S of the $BaSO_4$ by mass spectrometer (IR-MS) and calculated δ^{34}S (‰) using the reference material (Canyon Diablo Troilite). Annual weighted-mean δ^{34}S was calculated from sulfate flux (kg ha^{-1} year^{-1}) and δ^{34}S in each period. We also determined δ^{34}S by the concentration method for the water samples of rainfall and streamwater in some cases.

Annual weighted-mean δ^{34}S and S deposition in rainfall were 4.1 ‰ and 6.4 kg ha^{-1} year^{-1}, respectively. δ^{34}S in streamwater was 4-5 ‰ higher than rainfall during late-wet and dry season, whereas δ^{34}S in rainfall and streamwater was mostly comparable during early and middle wet season. In late-wet and dry season, δ^{34}S in sub-soil water was particularly higher in the riparian zone near the outlet of the study catchment than in the area near the headwater and on the slope. Sulfate enriched ^{34}S might be increased due to bacterial dissimilatory S reduction in late wet season and retained in the sub-soil during dry season, which could be a main source for the streamwater sulfate during base-flow periods. Meanwhile, in early and middle wet season, streamwater sulfate could be directly affected by atmospheric S input. These heterogeneity of internal S dynamics should be considered to examine the effect of atmospheric deposition on soil and inland-water ecosystems in tropical dry forest. The project is supported by the grant from APN (ARCP2012-18NMY-Sase: ARCP 2013 -13 CMY -Sase).

Keywords: tropical dry forest, stream water, sulfur dynamics, stable sulfur isotope ratio, atmospheric deposition, soil water