Multi isotopic analysis of rainwater and inland water in acid sensitive areas

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Introduction: Acid deposition and other materials from atmosphere accumulates in ecosystem and may cause acidification of soil and inland aquatic environment. We’ ve studied about dynamics analysis and ecological impact evaluation of atmospheric deposition by sulfur isotopic analysis in high sensitivity areas for acid deposition. From 2014, we started strontium (Sr), lead (Pb), oxygen and hydrogen of water isotopic analysis for multilateral analysis by isotopic information of multiple elements. In this presentation, we outline isotopic ratio data in our study sites.

Method: Study was conducted in 2 catchments and 6 lakes shown in the figure. We collected rainwater, soil solution and streamwater in catchments and surface water in lakes. We determined Sr isotopic ratio by thermal ionization mass spectrometer (TRITON, Thermo Scientific), Pb isotopic ratio by double focusing type multi-collector ICP-MS (NEPTUNE, Thermo Scientific), oxygen and hydrogen of water isotopic ratios by water isotopic analyzer (L2120-i, Picarro).

Results and discussion: Sr isotopic ratio was determined from Dec. 2013 to Sep. 2015. In both catchments, $^{87}Sr/^{86}Sr$ of rainwater showed seasonal variation in range of 0.709±0.001 by contribution of soluble minerals (0.711±0.001) contained in continental dust in spring and sea salt (about 0.709) in winter. On the other hand, streamwater ratios were stable around 0.707 in Kajikawa and around 0.715 in Ijira, and these were widely different from rainwater. Soil solution indicated middle value of rainwater and streamwater. Sr concentration of rainwater were several μg/L even though in high concentration period, but streamwater were stable around 20 μg/L even though in lower concentration catchment Ijira. These results suggest that Sr leaching into streamwater is strongly contributed by geological Sr. In overviewing lakes data based on these results, Sr concentration of Ohataike, Oike and Banryu were around 15 μg/L, so these suggests that geological contribution is strong in these lakes. On the other hand, Sr concentration were around 3 μg/L in Yashagaike, Meike and Sawanoike which seems to be acid sensitivity is particularly high. In the case of these lakes, effect of bedrock weathering may be small and contribution of atmospheric deposition may be relatively large.

Pb isotopic ratio was determined from Apr. 2014 to Aug. 2015. In the case of $^{206}Pb/^{207}Pb$ and $^{208}Pb/^{207}Pb$, contribution of rainwater clearly appeared in streamwater ratios and response speed was also fast. Particularly in Kajikawa which catchment area is small, response time rag was shorter than one month. In plotting with two components of $^{206}Pb/^{207}Pb$ and $^{208}Pb/^{207}Pb$, all values of our study sites fit in the range of previous reported values of aerosols in East Asia (Nakano *et al.* 2006),especially plotted near range of Russia and Mongolia values.

Oxygen and hydrogen isotopic ratios of water were determined from Jun. 2014 to Jul. 2015. In both catchment areas, rainwater $\delta^{18}O$ and δD showed seasonal variations, but streamwater ratios were stable around yearly average of rainwater, so it suggests that streamwater may leach from rainwater after recharged and averaged in catchments in calm water situation. In both catchments, d-excess values of rainwater showed similar trend with variation range from 5 to 35, and effect of dry continental air masses appeared clearly in winter.

In poster presentation, we also discuss about mutual relationship between these isotopic ratios.

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Reference: Nakano, T. *et al.* 2006. Determination of seasonal and regional variation in the provenance of dissolved cations in rain in Japan based on Sr and Pb isotopes. *Atmospheric Environment* 40, 7409–7420.

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