Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AHW28-23 Room:314 Time:April 30 16:30-16:45

Rapid procedure for d15N and d18O determination and identifying nitrate sources in agricultural watershed

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The natural abundance of nitrogen (δ^{15}N) and oxygen isotopes (δ^{18}O) of nitrate (NO_3^-) can be a powerful tool to discriminate the source of NO_3^- in agricultural watersheds. This dual isotopic approach has been used successfully to evaluate the denitrification process in an upland vegetable-field dominant watershed. Recently, determination of δ^{15}N and δ^{18}O of NO_3^- has been updated using a autosampler for automatic analysis. In this study, we developed a further time-saving procedure, which advanced the time-event efficiency by controlling sample traps and 6-port valves. Moreover, the procedure was used to identify sources of riverwater NO_3^- in a rice paddy watershed in Tsukuba, Japan, where the irrigationwater was supplied from out of the watershed.

The δ^{15}N and δ^{18}O values were determined by isotope-ratio mass spectrometry (IRMS) after converting NO_3^- to N_2O gas using the denitrifier method. We conducted sample purge and determination at the same time. Our developed procedure doubled the sample throughput, saving the amount of He carrier gas and liquid N_2. It also engaged the versatile utility of IRMS, since changeover of equipment was not required. This rapid procedure can be applied to other trace gas analysis, which require cryofocus e.g. CO_2, and will contribute for GWG dynamics studies.

Using the developed procedure, we identified principal sources of NO_3^- in mainstream riverwater of the watershed. The δ^{15}N — δ^{18}O relationship during irrigation period indicated that NO_3^- in mainstream riverwater were mainly provided from mountainstream and irrigationwater, and that significant effects of denitrification on the decrease in NO_3^- concentration were locally limited at some irrigationwaters and drainagewaters in the watershed.

Keywords: agriculture, irrigation, IRMS, nitrate, stable isotope, watershed

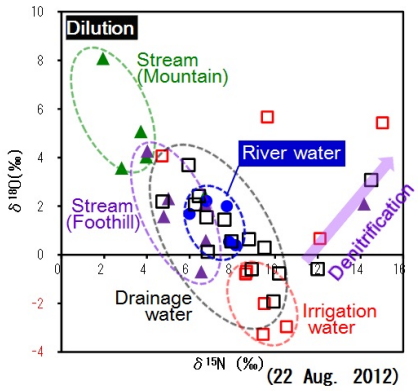

Fig.1 Identifying sources of riverwater nitrate using δ^{15}N and δ^{18}O values in an irrigated rice paddy watershed.