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The origin of nitrate in river water in Tohoku region based on the nitrogen and oxygen stable isotope ratios

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Nitrogen is one of the most important limiting factors of biological production, and regarded as a major factor of water pollution. Therefore, nitrogen concentration in aquatic environment has been monitored in the past. However, because the components of such environment are non-conservative, changes in these concentrations usually provide insufficient information for clarification of origins and pathways of nitrogen. On the other hand, the nitrogen stable isotope ratio can provide useful information to clarify the dynamics of nitrogen, as it reflects the organism-driven metabolism including uptake, nitrogen fixation, nitrification, and denitrification, as well as having the information related to the origin of these compounds.

Recently, nitrogen pollution assessment using the stable isotope technique has been recognized, as the nitrogen stable isotope ratios of anthropogenic nitrate originating from sewage and fertilizers have a unique range of δ^{15}N values, and a nitrogen removal process such as denitrification increases nitrate nitrogen δ^{15}N. In this study, we determined nitrogen and oxygen isotope ratios of nitrate for 372 river water samples in Iwate and Miyagi prefectures to examine the origin of nitrogen and environment of rivers.

Nitrogen isotope ratios tended to be high in urban and agricultural areas and low in mountain areas. These trends are consistent with the empirical knowledge that the nitrogen isotope ratio increases as the anthropogenic impact increases. A few high isotope values were observed in mountainous areas, however, there were some livestock farms up the river of the sampling points. It suggested the waste water from these farms has a significant influence on river water.

Oxygen isotope ratios tended to be high in mountain areas, such as Hayachine and Kurikoma, suggesting that atmospheric deposition (snow) was major source of nitrogen at that areas. High isotope ratios of both nitrogen and oxygen in some agricultural areas suggested the possibility of denitrification.