

## An isotopic study on origins of water and nitrogen pollution of shallow groundwater in densely populated areas of Kawasaki City, central Japan

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Around 30 water samples in Kawasaki City, the seventh largest city in Japan, was analyzed for water chemistry and isotope ratios of water ( $dD$  and  $d^{18}O$ ) and nitrate ion ( $d^{15}N$  and  $d^{18}O$ ) to investigate the origins of water and nitrogen pollution of groundwater in the highly urbanized area. All groundwater samples are from either springs or private wells at a depth of less than 15 m. As a result of the  $dD$  and  $d^{18}O$  analysis, it was proved that water leaking from drinking water mains is a major source of shallow groundwater recharge in the study area. The role of drinking water leakage in shallow groundwater recharge was found to be prominent for that in the lowland plains along Tama River, accounting for up to 40 % of the total groundwater recharge. With the help of nitrogen and oxygen isotopes of nitrate ion, we also found the serious effects of sewer leakage on shallow groundwater quality. Distribution of the nitrate ion concentration across the study area was highly heterogeneous, indicating the localized occurrence of denitrification as well as the effects of sewer leakage. Quantifying the effects of sewer leakage to both groundwater recharge and its quality is the subject of our future study.

Keywords: urbanized area, Kawasaki City, shallow groundwater, leakage from water mains, sewage leakage, nitrogen and oxygen isotopes of nitrate ion