Cross-sectional distribution in water chemistry and oxygen and hydrogen isotopic ratios in Fuku River, Saitama, Japan

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When discussing water environment of a river, it is essential to know not only the concentration of substances contained in river water but also the dissolved load which is a product of concentration of a given substance and river flow rate. It is therefore important to measure river flow rate and concentration of a given substance with accuracy. In the case of estimating the dissolved load, however, concentration of the substance is often represented by that at a single point in a river cross section, generally by the surface water sample at the center of flow, and less attention has not been paid to its representativeness in a river cross section. It also has been the case with hydrogen and oxygen isotopes, which are often used as tracers in the study on water environment of a river.
In this context, we carried out a field survey in December 2018 to elucidate a detailed concentration distribution of water chemistry (dissolved major ions and heavy metals) and isotopes (dD and $d^{18}O$) for the river cross section 7.7 m wide and ca. 0.5 m deep in Fuku River, Saitama, Japan. As a result, the difference in concentration over the whole cross section of the river was found to be 7.2 % or less for each of the dissolved major ions, whereas as much as 95 % for the dissolved heavy metals. For dD and $d^{18}O$ isotopes, there were differences in those ratios of some ‰and ca. 0.3‰, respectively. It should therefore be noted that considerable over- or underestimation in the dissolved load of substances is likely to happen when estimation is made by a conventional way in which the concentration of substances over the whole cross section is represented by a single surface water sample at the center of flow. This is particularly pronounced for the dissolved heavy metals. When evaluating the dissolved loads in rivers, it is therefore necessary to pay much more attention on where to sample water in a river cross section as well as how to measure the river flow rate accurately.

Keywords: River water, River cross section, Water chemistry, Oxygen and hydrogen isotope, Cross-sectional distribution, Dissolved load

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