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Mapping of water quality in the Obitsu and Kamo rivers on the Boso Peninsula, Japan.

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This study investigated downstream variation in the chemical composition of river waters in terms of the interaction between hydrologic cycles, human activity, and geologic composition in a drainage area. We used the Obitsu and Kamo rivers and their tributaries in the central part of the Boso Peninsula, as a case-study field of this research. We analyzed 50 dissolved elements and stable isotopes of hydrogen, oxygen, sulfur, and strontium using 150 water samples taken form the two river systems during three summer seasons from 2009 to 2011. On the basis of spatial variations in the concentration of dissolved elements and stable isotopic ratios of the four elements, we discriminated the following three major factors, which seem to have controlled the water quality in the two river systems.

(1) Air-water cycles: The deuterium-excess shows local decreases as a response to the construction of some reservoirs and also shows higher values in the upstream areas, as having already been observed in other areas. In contrast, the hydrogen isotopic ratio shows spatial variation opposite to the altitude and continental effects in the upstream areas. Thus, we need to clarify spatial variation in the isotopic composition of rainfall for the better understanding of a major process of air-water cycles in a small drainage area.

(2) Artificial contribution: The concentration of nitric acid increases in lowlands and also at the foot of small mountains as a response to the increase in population, housing, and agricultural fields in local association with stock raising. The concentration of Cl and Na, together with K, Rb, and Cs, show local increase in some tributaries in the upstream areas. These areas are also characterized by a higher $^{87}Sr/^{86}Sr$ ratio in river waters, and the water quality is interpreted to be polluted locally by water drained from chloride mineral springs. Furthermore, the sulfur isotopic data suggest that the chloride mineral springs have seeped after fossil brine had been affected by sulfate reduction, mixing with rainwater, and reacting with the host sedimentary successions in a subsurface environment.

(3) Geological effects: The southern tributaries of the Kamo River flows out from the Mineoka Mountains, which consists mainly of mafic and ultramafic rocks, and are characterized by a higher concentration of Mg, Ni, and Cr, and by a lower concentration of Si, K, Rb. Cs, together with a lower $^{87}Sr/^{86}Sr$ ratio. A lower $^{87}Sr/^{86}Sr$ ratio also characterizes upper reaches of both the Obitsu and Kamo rivers, where volcaniclastc sediments are developed. The drainage basin of the Obitsu River consists mainly of siliciclastic sedimentary rocks and is also characterized by the Kanto Loam in the uppermost sedimentary successions in the lower reaches. Thus, the water quality of the lower reaches is characterized by a higher concentration of Mg, Si, V, in association with a lower $^{87}Sr/^{86}Sr$ ratio. In contrast, the middle reaches of the Obitsu River are represented by turbidite successions and the river water is represented by a higher concentration of Mo and by a higher $^{87}Sr/^{86}Sr$ ratio. Locally, the upper reaches of the Kamo River are also characterized by a higher concentration of Cl and Na, in association with a higher $^{87}Sr/^{86}Sr$ ratio. This locally observed higher signal is interpreted to represent an effect of fossil brine from the sedimentary successions. Although the $^{87}Sr/^{86}Sr$ ratio in river waters is sensitive to the geologic composition in the drainage basins, we have not found any distinct spatial variation in the $^{87}Sr/^{86}Sr$ ratio of channel-floor sediments of both the Obitsu and Kamo rivers. Thus, we should separately analyze chemical composition of primary and secondary minerals of the channel-floor sediments for the better understanding of the interaction between the river waters and channel-floor sediments.

Keywords: Water quality, Obitsu River, Kamo River, Boso Peninsula