Geochemistry of river water in the Okayama and Tottori Prefectures, Japan

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In order to evaluate the effect of water-soil (rock) interaction, as well as human impact on the geochemical nature of river water, we have collected 695 river water samples from 454 locations in the Okayama and Tottori Prefectures, Japan. The area is ideal for such study because (1) the geology of the area is well studied, (2) there is a sharp contrast in the amount of precipitation between the southern Okayama and northern Okayama to Tottori, and (3) the population density is highly variable. We have measured the major dissolved components, trace element concentrations, and O-H isotope ratios for all of the samples, along with Sr and S isotope ratios of the selected samples. Using these data, the high-resolution geochemical maps of the two prefectures were constructed.
Both the oxygen and hydrogen isotope ratios display a clear altitude effect. The d-excess, on the other hand, is high in the northern Okayama and Tottori Prefectures (>20), and gradually decreases towards the southern Okayama (5~15). This pattern can be explained by considering the O-H isotopic signatures of the precipitation (e.g Mao 2017), as well as the difference in the amount of precipitation in the two areas. The concentration of some elements seems to correlate well with the type of rocks exposed in the area. For example, Ca and Sr concentrations are high in the areas where limestones are exposed, whereas Cr and Ni concentrations are generally high in the areas dominated by ultra-mafic rocks. In the Mt. Daisen area of the western Tottori Prefecture where dacitic volcanic rocks are common, the concentration of Si, V, Rb, Cs is high. These observations suggest that the concentration of some elements in the river water is strongly controlled by the geochemistry of rocks exposed in the area. The concentration of some dissolved constituents such as SO_4 and NO_3, on the other hand, seem to correlate well with the population density. This may imply that human activity (industrial and agricultural) is responsible for the elevation of SO_4 and NO_3 concentrations in the river water.

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