Hydrogen and oxygen stable isotopic mapping that allows us to investigate water cycle regimes over Japanese Island

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In the earth surface water cycle, waters fall to the surface ground as precipitation, and then flow through ground and stream waters, and finally flow back to the sea. Oxygen and hydrogen isotopic ratios of water molecular reflect the source mixing and physical processes, i.e., evaporation, in such fluid dynamics. Many studies have applied these tools in revealing processes taken placed in regional watershed systems. Even enormous data have adequately been accumulated by the year 2020, only few researches have summarized and integrated these datasets in regional and continental scales. This study collected these data covering whole Japanese Islands from published literatures, domestic reports and internet websites, for all water regimes including precipitation, groundwater, spring water, and river water to discuss their overall flow systems. As a result, some major findings were obtained. First, it was confirmed that the waters at both higher latitude and the higher altitude showed lower isotopic ratios for precipitation, spring water and river water, that are latitude and altitude effects, except for groundwater which isotopic signatures are formed by involvement of other factors. Spatial distributions of surface and subsurface waters correspond well with that of precipitation. Second, water flow features were examined by characterizing the slope of regression lines on the delta diagram. It was suggested that precipitation fallen on the mountains percolates into ground and seeps mostly from mountain foots as springs that merge to become headwaters in the mountains. Most of downslope aquifer waters more resemble in isotopic compositions to these headwaters rather than mountain waters. The spring waters at lower altitude must be recharged in mountains with lower altitude where these headwaters present. The downslope groundwaters and, to more extent, rivers are most significantly affected by evaporation. Presence of NE-SW trending lower d-excess anomaly belt was suggested in the central part of Japanese Islands, which formation processes should be address in future work.

Keywords: stable isotopes, precipitation, groundwater, river water, spring water

