

Relationships between altitude and stable isotope compositions of surface waters and plants in the northern Japanese Alps region

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Surface waters and plants at different altitudes were collected from the area surrounding Yarisawa, ranged from Kamikochi to Mt. Yarigatake in the Chubu Sangaku National Park, Nagano. Thereafter, we analyzed the oxygen stable isotopes ($\delta^{18}\text{O}$) in the surface waters and the ratio of oxygen, nitrogen ($\delta^{15}\text{N}$), and carbon ($\delta^{13}\text{C}$) stable isotopes in plants. The level of $\delta^{18}\text{O}$ in the surface waters decreased with increasing altitude; this indicated the altitudinal effects on $\delta^{18}\text{O}$ as well as other reported regions. On the other hand, the amount of $\delta^{18}\text{O}$ in plants had a tendency to increase with increasing altitude. In general, the $\delta^{18}\text{O}$ values of plants were determined by (1) the $\delta^{18}\text{O}$ values of the soil water from the root and (2) the isotope effect on the transpiration of leaves. When the relative humidity is low, the isotope effect on the transpiration of leaves greatly increases, and subsequently, there is an increase in the $\delta^{18}\text{O}$ values of the leaf water. In fact, it is believed that the relative humidity in areas at high altitudes is very low locally because these areas, particularly in the mountain ridges, have little shade and are dry. The results of this study suggest that altitudinal fluctuation of the isotope effect by the difference of relative humidity negated and exceeded in the altitudinal fluctuation of $\delta^{18}\text{O}$ values of soil water. Moreover, the altitudinal difference did not affect the $\delta^{15}\text{N}$ values of plants. Furthermore, the $\delta^{13}\text{C}$ values of plants showed a weak tendency to increase with increasing altitude. No distinct differences were observed in the $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values of plants between species. Differences in the living environmental conditions will be examined hereafter.