High resolution carbon reservoir effect fluctuations derived from surface water dissolved inorganic radiocarbon of Fuji Five Lakes

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In terrestrial paleoenvironmental research, high time resolution is required for meaningful results; varve deposits in lakes and stalagmites have been used to achieve high time resolution. However, there are limited areas where good geological samples with long growth periods, such as varve deposits and stalagmites, can be found.
Radiocarbon dating is a method applicable to a wide area, but the carbon reservoir effect causes the water and sediments to appear apparently old. This is due to the exchange of ^{14}C-depleted substances derived from biological remains and host rocks during the process of fixing and transporting carbon from the atmosphere. Estimation of reservoir effects in marine samples has been extensively researched, but recent studies have pointed out the possibility of seasonal variation, and detailed studies are still ongoing. There are few studies of reservoir effects on land due to complicated carbon transfer processes and underdeveloped measurement techniques, and no studies on seasonal variations. However, as described above, lake sediment is important for paleoenvironmental analysis, and it is important to estimate the reservoir effects within lake water with high accuracy.
Lakes Motosu, Shoji and Sai only have temporal inflow and outflow rivers, and the lake water is defined by precipitation and groundwater inflow. Therefore, the transportation pathway of water is simple and suitable for estimating the carbon transport process in the hydrosphere. By measuring the radiocarbon concentration ($\Delta^{14}C$) of precipitation, groundwater, and lake water, it is possible to clarify the effect of groundwater on the reservoir effect of lake water. In this study, for the first time, we measured $\Delta^{14}C$ of lake water once a month at Fuji Five Lakes, compared with $\Delta^{14}C$ of groundwater. The water balance was then calculated from the groundwater recharge altitude, lake observation data, and the box model of groundwater and lake water $\Delta^{14}C$. The results of these studies were comprehensively considered, and the mechanism of the reservoir effect in the Fuji Five Lakes was clarified.
The result show that Lake Kawaguchi in August had the lowest $\Delta^{14}C$ and Lake Motosu in January had the highest $\Delta^{14}C$. In Lakes Motosu and Kawagushi, $\Delta^{14}C$ was found to increase in winter. No clear seasonal changes were observed in Lake Sai and Lake Yamanaka. From the results of the water balance, it was found that the inflow of groundwater reached its maximum in winter, which suggests groundwater inflow is caused by the rise of groundwater pressure due to snowmelt.
Regarding the relationship between the lake water and the reservoir effect of the sediment, the lake water $\Delta^{14}C$ in summer and the $\Delta^{14}C$ of the surface sediment coincided within Lakes Motosu and Kawaguchi. It is possible that $\Delta^{14}C$ of sediment in both lakes are defined by the fixation of lake water ^{14}C due to the expansion of biological production in summer, and that lake water $\Delta^{14}C$ in summer can be used to estimate the reservoir effect of lake sediment.

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