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Spatiotemporal variations in isotopes of oxygen and hydrogen of precipitation at Saijo city in Ehime prefecture

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The isotopic compositions of oxygen (δ^{18}O) and hydrogen (δD) of wet precipitation provide fundamental information for atmosphere-hydrosphere cycle. Global change of δ^{18}O and δD has relation to meteorological components such as air temperature and precipitation amount. Spatiotemporal information of δ^{18}O and δD of precipitation is important to understand the atmosphere and water cycle in local basin. However, there have been few studies of local basin due to the difficulty of long-term collecting precipitation.

We determined δ^{18}O and δD of monthly wet precipitation at 6 sites in Saijo from November in 2008 to December in 2014 to elucidate the precipitation process in local basin. The isotopic compositions of precipitation were heterogeneity within the investigation area (<several hundreds km^2). This result is assumed to concern the origins and formation processes of clouds and precipitation process. We compared the seasonal variation in the δ^{18}O and δD of precipitation among the different altitude sites.

The inclinations of monthly meteoric line had distinct values, approximately 8, at each site. On the other hand, the values of deuterium excess (d-excess) ranged from 20 to 30 ‰ in winter and from 3 to 10 ‰ in summer. The values of d-excess at Jojusha (1,280 m above sea level) is 3 ~ 10 ‰ higher than those of another sites during spring and autumn. In spring, the values of d-excess at Jojusha showed higher and the δ^{18}O and δD had 3 ‰ and 20 ‰ lower than those of precipitation at the lowest altitude site (20 m on the roof of city office), respectively. On the other hand, during summer and early autumn, the δ^{18}O and δD of precipitation at Jojusha had 1 ‰ and less than 10 ‰ lower than those at the city office, respectively. These results indicate that the isotopic compositions of precipitation in Saijyo had obviously seasonal variations. Re-vaporized vapor generate precipitation including higher values of d-excess. Therefore, the isotopic signatures of precipitation at Jojusha in spring were ascribed to vapor from evapotranspiration, requiring any more consideration. The precipitation at the city office had low d-excess and high δ^{18}O and δD in winter, suggesting that the re-evaporation effect for condensation of raindrop from clouds.

Keywords: precipitation, oxygen isotope ratio, hydrogen isotope ratio