Long-term increasing trend of line-conditioned excess in groundwater

*Masanori Katsuyama[1]

1. Graduate School of Agriculture, Kyoto University

The isotope composition in water is commonly used for the analysis of hydrological processes. According to the recently proposed two water world hypothesis, precipitation will separated into two water pools such as the stored portion in soil pore which is much evaporated and used by vegetation, and the rapidly infiltrated portion which is less affected by evaporation and recharge the stored ground- and stream water. The line-conditioned excess (or lc-excess) is an appropriate indicator to find these separation. This method defines the offset between a meteoric water line and each water samples, with a negative value indicate the effect of evaporation. The long-term observation of isotope composition is ongoing at the Kiryu Experimental Watershed (KEW). The isotope composition in the rain water does not have a clear increasing or decreasing trends for the observation period. The long-term trend of the lc-excess was also not found in soil water and shallow groundwater. On the other hand, the increasing trend of the lc-excess was found in deeper groundwater. This fact means that the effects of evaporation on the infiltrating water are decreasing. The d18O in the groundwater was slightly decreasing. If the global warming directly effects on the isotope composition in the groundwater, the d18O may increase. Thus, the decreasing d18O and the increasing lc-excess may be the results of the change of local hydrological processes. Recently, it is reported that the extreme rainfall events are increasing in Japan, including in KEW. Therefore, the trend of lc-excess in groundwater suggest that change of rainfall patterns cause the increase of rapid infiltration and recharge of groundwater body. Moreover, the long-term trend of groundwater isotope composition was observed at five locations, Hokkaido, Toyama, Yamanashi, Tottori, and Miyazaki prefectures in Japan and one location in California, USA using commercially available bottled waters. Within these locations, similar trend as KEW was found at Tottori and California. Although the depth and size of groundwater body and their residence time may effect on the patterns and trends of isotope composition, the results shown here suggest that the importance of the long-term monitoring of the groundwater. The effects of extreme rainfall events and vulnerability of each region should be evaluated based on the intensive observations at highly installed watersheds, as well as the utilization of easily available samples such as bottled waters.

Keywords: Groundwater, Stable isotope in water, local meteoric water line, line-conditioned excess, two water world hypothesis, extreme events

