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Long-term monitoring of stable isotopic compositions of precipitation over volcanic island, Jeju, Korea

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Stable isotopic compositions of precipitation can be widely used to understand moisture transport in the atmosphere, proxies for paleoclimate and interactions between groundwater and precipitation. Over Jeju volcanic island, located southwest of the Korean Peninsula, precipitation penetrated directly into the highly permeable aquifer is the main source of groundwater. In this study, long-term stable isotopic compositions of precipitation over Jeju Island are characterized to describe spatial and temporal patterns for hydrology and paleoclimate. At fifteen sites from September 2000 to December 2003, precipitation samples were collected and analyzed by Isotope Ratio Mass Spectrometer at the Korea Basic Science Institute. Compared to Lee et al. (2003), the two seasonal local meteoric water lines widen, which may change the relative contributions of winter and summer season precipitation to the groundwater recharge. The precipitation isotopes are inversely correlated with precipitation amount in summer, whereas they do not show a strong correlation with surface air temperature. The precipitation isotopes monthly averaged relatively show a periodic function (R2=0.63 and 0.40 for hydrogen and oxygen, respectively), and deuterium excess (d-excess=δD-8$\times\delta$18O) shows a strong pattern of quadratic function (R2=0.97), which is related to a seasonal change of air masses. Altitude effect of precipitation isotopes, which can be a clue to reveal sources of groundwater, can be observed in every aspect of the volcanic island (for the oxygen isotope, -0.14‰ for east and west, -0.18‰ for north and -0.085‰ for south per 100 m). Our analysis of precipitation isotopes will be helpful to provide limitations and opportunities for paleoclimate reconstruction using isotopic proxies and water movement from atmosphere to subsurface.