Altitude effects of stable isotopes of spring water in Kumamoto area

Koushirou Nagao[1], *Kimpei Ichiyanagi[1]

1. Kumamoto University

This study investigated the relationship between stable isotope ratios (δ 2H and δ 18O) and sampling elevation of spring water in Kumamoto area. There are some previous studies which have estimated the recharge elevation of spring water using the altitude effects of stable isotopes of precipitation. Because isotope ratios of precipitation have seasonal variation, it should be sampled throughout the year to estimate annual mean value. On the other hand, isotope ratios of spring water might be considered to represent the annual mean value of the watershed. However, it should be noted that the sampling elevation of the spring is different from the recharge elevation of the watershed. In this study, we collected samples from 30 spring water around Kumamoto and Aso areas from July to December 2022. The δ 2H and δ 18O were measured using the Water Isotope Analyzer (Picarro L2120-i) at Kumamoto University. Also, we collect isotope ratios of spring water observed from 2008 to 2011 in Kumamoto, Aso and Oguni areas from previous studies. A total of 118 springs were examined the relationship between stable isotope ratios and their sampling elevations. As a result, the δ 2H and δ 18O of all spring water have a relationship of δ 2H=5.9× δ 18O-3.7 in the δ -diagram. Compared to the Local Meteoric Water Line (LMWL) at Kumamoto, the spring water with low isotope ratios tend to be close to the LMWL of winter and those with high isotope ratios to the LMWL of summer. This may be due to evaporation or differences in the portion of summer and winter precipitations depend on the sampling elevation. The slope of the relations between δ 18O (δ 2H) and sampling elevation in all spring samples was -0.0019‰/m (-0.0122‰/m). These values are close to the altitude effects of precipitation observed in Kumamoto and other area of Japan. Furthermore, comparing δ 2H values of spring water before and after the 2016 Kumamoto earthquake at same sampling sites, the values after the earthquake are generally about 1.5‰ lower than those before the earthquake. Assuming the altitude effect obtained in this study (-0.0122‰ /m), the recharge altitude of springs were estimated about 100 m higher after the earthquake. This might be the increase of groundwater from the mountain body after the Kumamoto earthquake. In future, we have to consider the relationship between recharge elevation and sampling elevation of the watershed.

Keywords: stable isotope ratio, spring water, altitude effect, Kumamoto

