

Variability of stable isotopes in precipitation based on the result which observed at 6 sites for long period

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The stable isotopes of oxygen and hydrogen are useful to consider the water cycle and groundwater flow, because these isotopes do not react with a rock under the normal condition and isotopic ratios are constant with the time. Additionally, water (H₂O) consists of Oxygen and Hydrogen, so stable isotopes of oxygen and hydrogen are used well for hydrological studies.

Because the stable isotopes of oxygen and hydrogen are affected by the elevation, latitude, distance from the coast and air temperature, these isotopic ratios are different in each site. And these isotopic ratios of same month are variable if the year is different. It is also thought that the global warming will influence the stable isotopic values. Therefore, to grasp the characteristics of long term variation of stable isotopes in precipitation is objective in this study.

The observation sites are Tsukuba City (from 1992 to 2006), Ogawa Town (from 1993), Utsunomiya City (from 1998), Kumagaya City (from 2007), Matsumoto City (from 2009) and Kyoto City (from 2009 to 2010). In the site of Matsumoto and Kyoto, precipitation samples have been collected at several points for confirming the altitude effect. The monthly precipitation samples have been collected at each site. The stable isotopes of oxygen and hydrogen were analyzed for all samples.

The seasonal variation of stable isotopes dose not appear clearly, however, the isotopic ratios are relatively low in autumn season which is affected by the typhoon and autumnal rain front, and also low in January and February. From the result of study of Yabusaki and Tase (2005), it is considered that the isotopic ratios are influenced by the air temperature in winter season and influenced by the precipitation amount from summer to autumn season. Because the isotopic ratios are relatively low in the observation site of Matsumoto City, the altitude effect and inland effect is confirmed. Thus the variation of stable isotopes is almost same in each observation site, so it is indicated that the source of water vapor which is origin of precipitation is same at the site of Kanto and Chubu district. The variation range of isotopic ratios in precipitation is relatively small from April in 1998 to January in 2000 and from September in 2007 to November in 2011. It may be affected by the precipitation amount or air temperature. The variation range of isotopic ratio is Utsunomiya City < Ogawa Town, Tsukuba City < Matsumoto City. Because the air temperature is relatively low and the snowfall is relatively large in Matsumoto City, it is thought that the variation of isotopic ratios is greatly. The seasonal variation of d-excess values, that is low in summer season and high in winter season, appears obviously. Therefore, it is assumed that the prevailing source of water vapor is Pacific side in summer season and Japan Sea side in winter season. According to the long term variation of the stable isotopes, air temperature and precipitation amount, the air temperature is rising gradually, however the isotopic ratios are decreasing gradually. As the reason of the decrease of isotope ratios, it is considered that the isotopic ratios are related to rainfall intensity.

Keywords: precipitation, stable isotopes, long term variation of stable isotopes