

Characteristics of stable isotopes for precipitation at the mountainous region in the eastern part of Matsumoto

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Matsumoto basin is located to slightly northward from the center of the Nagano Prefecture and surrounded the mountains (Hida-mountains and Tsukuma mountains). The complex alluvial fan is formed by the Metoba and Susuki river in the east part of the Matsumoto basin. There is some aquifer in the Matsumoto basin and large quantity of groundwater is stored in the basin. The people who live in Matsumoto city have been used the groundwater or spring water for long period, and now that the water supply facilities is completed people use the groundwater or spring water for drinking water.

For estimating the recharge area of groundwater or spring water in Matsumoto basin by using the stable isotopes of oxygen and hydrogen, precipitation samples have been taken at four points on the east side of Matsumoto basin since June, 2009. The water samplers which have the parts to prevent the evaporation of water are settled at P-1 to P-4. The elevation of P-1 is 592m, P-2 is 1,000m, P-3 is 1,300m and P-4 is 1,900m. The monthly precipitation samples are taken at four points from May to November and taken at only two points (P-1 and P-2) from December to April.

Thus the stable isotopes of oxygen ($d^{18}\text{O}$) and hydrogen ($d\text{D}$) in precipitation are relatively low in the place of high elevation, the altitude effect is existed. The altitude effect is Matsumoto is -0.17 permil/100m ($r^2=0.998$) for $d^{18}\text{O}$ and -1.0 permil/100m ($r^2=0.994$) for $d\text{D}$. Since the precipitation amount is large with increasing the elevation, the amount effect also will probably exist. Usually the $d^{18}\text{O}$ and $d\text{D}$ in precipitation have no seasonal variation in Japan, however those in Matsumoto are relatively low in winter season (from November to February). As a result of calculation by using the stable isotopes of precipitation and groundwater samples, it is estimated that the average recharge are of groundwater in Matsumoto basin are estimated at the area from 1,300m to 1,600m above the sea.

The d-excess values have a seasonal variation which is relatively low at summer period and relatively high at winter period. However, the d-excess values in Matsumoto is relatively low than other area (e.g. Niigata prefecture, southern part of Nagano prefecture and western part of Yamanashi prefecture).

The local meteoric water line (LMWL) is $d\text{D} = 7.16d^{18}\text{O} + 2.58$ ($r^2=0.928$) for P-1, $d\text{D} = 7.12d^{18}\text{O} + 2.26$ ($r^2=0.902$) for P-2, $d\text{D} = 6.18d^{18}\text{O} + 7.00$ ($r^2=0.681$) for P-3 and $d\text{D} = 8.00d^{18}\text{O} + 13.3$ ($r^2=0.976$) for P-4. The slopes of LMWL at P-1, P-2 and P-3 are relatively gentler than that of Craig's meteoric water line ($d\text{D} = 8d^{18}\text{O} + 10$). On the other hand, the slope of LMWL at P-4 is relatively steeper than that of other points and almost same the slope of Craig's meteoric water line. Thus there is almost no the observation in the mountainous region where the elevation about 2,000 meter, it is important to continue the observation of this study.

Keywords: Matsumoto basin, Utsukushigahara plateau, precipitation, groundwater, stable isotope