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A study on the origin and recharge process of shallow groundwater in the east Musashino upland, Tokyo

Takeshi Hayashi[1*], Masaya Yasuhara[2], Akihiko Inamura[2]

[1]Akita University, [2]GSJ, AIST

Water environment of urban area largely varies with stage of urbanization. Generally, infiltration rate of precipitation has been decreased because of increasing of impermeable surface such as constructions and paved roads and of developing of sewerage network. On the other hand, leakage from sewerage becomes the source not only of groundwater but of pollutants. To maintain urban water environment and use groundwater as water resource, it is important to clarify the origin and recharge process of groundwater.

East Tokyo Metropolis is the economic center of the Tokyo Metropolitan Area and has been developed since the end of 19th century. East Tokyo Metropolis is topographically divided into the western upland (Musashino upland) part and the eastern lowland (Tokyo lowland) part. In the upland part, about 280 springs are still remains in 2003 (Tokyo Metropolitan Government, 2003). Also, Inamura and Yasuhara (2008) studied delta-18O and delta-D of groundwater that discharged to the Shakujii River that flew on the upland and evaluated origin of the groundwater. According to Inamura and Yasuhara (2008), the groundwater is mainly recharged by precipitation. These results suggest that infiltration route of precipitation still remains in the upland area. This study aims to clarify the origin and recharge process of shallow groundwater in the Toshima Ward that is located on the upland. Toshima Ward is surrounded with the Shakujii River and the Kanda River, and the central part of this ward is a city center. Western and eastern part of the ward is residential area. Prevalence of networks of water pipe and sewerage in this ward is 100%. We collected groundwater samples from 13 shallow private wells (depth is shallower than 10m) and 9 deep wells (depth is 20 to 30m) and measured major dissolved ions and stable isotopic compositions of O and H. Also, land-use, especially grassland and bare ground, in around the shallow wells were checked by using Google Maps and Street View.

Delta-18O and delta-D of all groundwater samples ranged between precipitation (weighted average of GNIP TOKYO data) and tap water (Inamura and Yasuhara, 2008). This result showed that the groundwater in this area was recharged by precipitation and tap water. We calculated mixing ratio of precipitation and tap water using isotopic data of groundwater samples and two end members (precipitation and tap water). As a result, contribution of precipitation was from 48.4 to 75.9% except for one sample (shallow groundwater: 20.5%). On the other hand, ratio of grassland and bare ground in topographical catchment area of shallow wells that were estimated from topographical map with a scale of 1:2500 and 5m mesh DEM were 11.6 to 22.4%. The contribution of precipitation and the ratio of grassland and bare ground showed positive correlation. Results of this study showed that precipitation was still major source of groundwater. Infiltration routes of precipitation were considered to be not only public parks and car parks but also yards and under of eaves in detached houses.

Keywords: urban groundwater, land use, recharge process