

Origin of the high-chloride groundwater in the central part of the Kanto Plain from the viewpoint of noble gas hydrology

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There exist three regions in the Kanto plain, central Japan, whose artesian groundwater is characterized by a high Cl⁻ concentration: 1) central parts of the Kanto plain (Saitama Prefecture), 2) south-east parts of Gunma Prefecture), 3) floodplains and deluvial uplands along the lower reaches of Kokai and Tone rivers (Ibaraki and Chiba Prefectures).

As for that in the central parts of the Kanto plain, confined groundwater with a high Cl⁻ concentration of up to 216 mg/l is obtained from the productive boreholes of 200-430 m depth. The area of Cl⁻-rich groundwater, spreading from the northwest to southeast, corresponds with the so-called Motoarakawa tectonic zone (ca. 10 km wide by 35 km long) bounded by the fault on its longer sides. The ³⁶Cl/Cl results of these high chloride groundwaters imply that admixture of meteoric water and sea water in the period of the Shimosueyoshi transgression (peak period at around 125,000 yrs. BP) is likely to account for its elevated Cl⁻ concentration (Yasuhara et al., 2011). Morikawa et al (2006) conducted dissolved noble gas analyses for the groundwaters in the Motoarakawa tectonic zone. The results of helium isotopes are as follows; (1) there is a tendency of high ⁴He concentration in the groundwaters inside the tectonic zone, (2) helium isotopic ratios (³He/⁴He) are relatively homogeneous with an end member of 0.8-1.1 x 10⁻⁶. Helium-4 concentration show clear positive correlation with chloride concentration. Combined with this correlation and characteristics of helium isotopic ratio, it is inferred that the groundwater from the tectonic zone is a mixture of meteoric water and high chloride saline water bearing with high ⁴He or is stagnant old groundwater and that the groundwater flow system is distinct from those from outside of the tectonic zone.

In this study, we investigated the noble gas in the deeper groundwaters (hot springs) around the Motoarakawa tectonic belt and the high-chloride groundwaters from south-east parts of Gunma Prefecture to elucidate the origin of water and chloride component in the central parts of the Kanto plain. Low ³He/⁴He ratios in the hot springs indicate that there is no interconnectivity between the high chloride groundwater and hot spring water around the Motoarakawa tectonic zone. In contrast, both ³He/⁴He ratio and correlative ⁴He and Cl concentration in the high-chloride groundwaters from south-east parts of Gunma Prefecture are similar to those in the groundwaters in the Motoarakawa tectonic zone.

Keywords: Kanto Plain, groundwater, chloride ion, Noble Gas, Helium isotope