

Origin of saline groundwater around the north margin of Kanto Mountains

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Oxygen and hydrogen isotopic compositions and major and trace elements (mainly Li⁺) have been investigated around the north margin of Kanto Mountains, central Japan to estimate the origin of deep and shallow saline groundwater (saline water). Saline waters from springs or shallow wells have been distributed in the mountainous area along Median Tectonic Line (MTL) or faults, while saline waters from deep wells (750-2000m depth) have been mainly obtained in the hilly and plane part of study area. On the basis of isotopic shift patterns on delta diagram, these saline waters can be divided into four end-members. All of them have similar dD values (about -20 per mil), but d¹⁸O values are different from each other.

Saline water A (Higashimatsuyama), which is withdrawn from deep well in the plane part, is plotted on meteoric water line (MWL), having lowest d¹⁸O value (-3.9 per mil) in the end-members. Saline water samples from deep wells located in the northwestern part of Kanto Plane are plotted along MWL as well as deep groundwater samples associated with natural gas in Minami-Kanto and Niigata gas field. Because it has been suggested that deep groundwater in natural gas field is originated from paleo-sea water trapped in marine deposits, the origin of this type saline water may be a modified paleo-sea water of which ¹⁸O have been slightly depleted.

Saline water B (Myogi and Kamikawa) has higher d¹⁸O value (-1.0-0.0 per mil) than that of Saline A, while has lower Cl⁻ concentration (about 6000 ppm) which is a half of the other end-members. Most of saline water in study area plotted on mixing line between meteoric waters and sea water on the plots of dD vs Cl⁻ concentration, while this type saline waters are not plotted on it. Similar saline water samples are produced from deep wells drilled in Tertiary sedimentary rocks at Niigata and Miyazaki Plain. These saline waters might be derived from dehydrated interlayer water in smectite originated from smectite-illite conversion (Ito et al., 2004 and Ohsawa et al., 2006).

Saline water C (Yashio, Kannagawa, Sannagawa, Ayukawa, Kamiizumi and Nishishimonita) located on MTL and Jushi-Kuroya fault branched from MTL, and have highest d¹⁸O value in saline waters of study area. Oxygen and hydrogen isotopic compositions are sifted from MWL towards magmatic water. In addition, this type saline waters have high concentration of Li⁺ and Boron. Geochemical characteristics of saline water C is similar to that of the slab derived-waters, as a Arima-type thermal brine, which are widely distributed along MTL. Therefore, saline water C may be considerably affected by the slab derived-water which originated from dehydrated water from subducting slab.

Saline D (Isobe and Kanra) is estimated to be a mixture of saline A or B and saline C, showing a mixing trend on the plots of Cl⁻ vs Li⁺. However, we can not determine which saline water (A or B) contribute to the formation of saline water D as a end-member of lower d¹⁸O using by only delta

diagram. Saline water samples which has slight isotopic shift on delta diagram are roughly determined by using the data of trace elements, as Li^+ and Boron, and geographical setting.

Keywords: saline water, Na-Cl type groundwater, non-volcanic hot spring, deep-crustal fluid, hydrogen and oxygen isotopes, lithium ion