Stable and noble gas isotopic study of geothermal and ground waters in North Hokkaido, Japan

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Geothermal and ground waters are distributed along the west coast and in the inner region of North Hokkaido, Japan. The waters in the former group are relatively high in temperature. Stable (D,O) and noble gas isotopic compositions of 23 geothermal and ground waters were analyzed to investigate their origins. The Cl concentrations varies from 45 to 19300 mg/L and the δ D values are in the range of -90 to -8 ‰. The δ D- δ ^{18}O plots show liner relationship which can be explained as a simple mixing of local meteoric waters and altered sea water with oxygen shift of 5 ‰. However, δ D-Cl plot demonstrates a contribution of additional water component of different origin. The 3rd component has δ D of -20 ‰ and Cl concentration of 6000 mg/L. The matrix analyses of chemical compositons of the studied waters also support this view and the geothermal water at Toyotomi is the closest to the compositon of the 3rd ground water component.

Noble gas concentrations are similar to those of air saturated water except for the enrichments of He in the samples. ^{3}He/^{4}He ratios in these waters are in the range of (0.1 - 5) $\times 10^{-6}$, which indicate a contribution of mantle and crustal He to the geothermal and ground waters in the studied area. The Toyotomi geothermal water has ^{3}He/^{4}He ratio of 5.5×10^{-7} with high ^{3}He/^{20}Ne ratio (～700), which indicates a crustal He input with a smal amount of mantle-derived He. These features imply that the 3rd groundwater is of deep origin.