

Concentrations of halogen elements and $^{129}\text{I}/^{127}\text{I}$ ratios in highly saline groundwaters collected in Hokkaido

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Hot springs and groundwaters with high halogen contents occur in many places in Japan. Since halogens are highly water-soluble and highly mobile, their concentrations and isotopic composition should reflect the rock formations where the fluids originated. It is known that several hot springs in Hokkaido, the northern Japanese island, contain high concentration of halogens including iodine. However, the origin of the salts in these springs is not well known. The purpose of this study is to understand the origin of high salinity groundwaters related to the geological settings of the area. In this study we analyzed I, Br and Cl concentrations in hot spring waters collected from various places in Hokkaido and compare their relative abundance. We also have analyzed ^{129}I (half-life 15.7 m.y.) in the fluids in order to estimate the age of the dissolved iodine.

Analytical results obtained by ICP-MS and an ion chromatography show that the concentrations of I, Br and Cl in the fluids ranged between 0.04 - 650 microM, 0.5 - 2500 microM and 0.4 - 960 mM, respectively. Major iodine species was found to be iodide.

Relationships between Cl and I concentrations are classified as 3 types based on their regional distribution, i.e. Wakkanai area, Urausu area and other areas. In case of the relation between Cl and Br, an additional type (Ishikari area) was also observed. In Wakkanai area, concentrations of I increased exponentially with those of Cl, while in Urausu area, it increased logarithmically with Cl concentrations. Samples from the other areas should be a mixture of 3 end-members (meteoric water, seawater and hot spring water).

$^{129}\text{I}/^{127}\text{I}$ ratios determined by AMS (accelerator mass spectrometry) ranged between 0.05×10^{-12} and 0.38×10^{-12} . Samples collected from Urausu area showed a very low $^{129}\text{I}/^{127}\text{I}$ ratios of 0.05×10^{-12} to 0.1×10^{-12} . Low values are also observed along the longitude of 141-142 deg which are markedly lower than the $^{129}\text{I}/^{127}\text{I}$ ratios observed in iodine-rich fluids in other areas in Japan, such as Chiba (0.18×10^{-12}), Niigata ($0.3-0.4 \times 10^{-12}$, Tomaru et al. 2009) and Satsuma-Iwojima (0.78×10^{-12} , Snyder et al. 2002). Considering the ^{129}I systematics (Fehn et al. 2004), iodine age in Hokkaido samples of the lowest $^{129}\text{I}/^{127}\text{I}$ ratios is estimated to be 60-70 Ma. This indicates that the iodine-rich fluids are likely to be derived from old marine sediment, which was later uplifted to form older rock formations in the present day coastal region of Hokkaido.