

## A multi-isotope study on Cl-rich groundwater in the lower reaches of Tone River, Japan

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Groundwater in an alluvial plain extending along the Tone River in the southern parts of Ibaraki Prefecture and northwestern parts of Chiba Prefecture, Japan is known to have a high Cl concentration. A multi-isotope study based on <sup>2</sup>H, <sup>18</sup>O, <sup>3</sup>H, <sup>13</sup>C, <sup>14</sup>C, <sup>4</sup>He and <sup>36</sup>Cl has been in progress to elucidate groundwater system of the region with special reference to the origins and residence times of both water and Cl. Around 95 groundwater samples from a depth interval between 5 and 250m were analyzed to have a clear grasp of the geochemical status quo of groundwater in the Holocene sediments (alluviums) of the alluvial plain and the underlying Pleistocene sediments. As a result, it was found that groundwater in the Pleistocene sediments in the depth of 80-150m has a Cl concentration of 62-200 mg/L and is characterized by the depleted delta-<sup>18</sup>O and delta-D values as well as a relatively old <sup>14</sup>C age of about 20,000 yrs. With regard to origins of water, a potential source is assumed to be the precipitation of low stable isotopic composition in the Last Glacial Maximum (peak period at around 20,000 yrs. BP) when the sea level of the Tokyo Bay was lower than the present by more than 100 m. The <sup>36</sup>Cl/Cl analyses indicate an admixture of *fossil* sea water trapped in the sediments during the Shimosueyoshi transgression (peak period at around 125,000 yrs. BP) or even earlier transgressions is likely to account for its elevated Cl concentration. In contrast, groundwater in the overlying Holocene sediments in the depth of 30-40m, which has a much higher Cl concentration of up to 768 mg/L, is characterized by a relatively young <sup>14</sup>C age of ca. 9,000 yrs. and the enriched delta-<sup>18</sup>O and delta-D values. Taking these measurements and <sup>36</sup>Cl/Cl analyses into account, groundwater in the Holocene sediments is assumed to have its Cl and water origins in sea water of the Jyomon transgression period starting around 10,000 yrs. BP and isotopically-enriched precipitation of the same period, respectively.

Keywords: Tone River, alluvial plain, Cl-rich groundwater, multi-isotope study, residence time, origins of water and Cl