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A multiple-isotope apporach to reveal the coastal hydrogeological system and its temporal changes.

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Multiple-isotope data and the results of the diffusion-sedimentation model were used to reveal the coastal hydrogeological system and its temporal change at a small catchment and its offshore extension, the Uto Peninsula, Kumamoto, Japan. Chloride concentration decreases gradually downwards, and the profile of the stable chlorine isotopic ratio showed the typical pattern formed by diffusion-controlled mass transport process. One-dimensional diffusion/sedimentation model explained the measured chloride profile and the fractionation of chlorine isotopes sufficiently well. The apparent residence time of groundwater below inter-tidal zone is on the order of 100 years while that below sea bottom is about 2000 years, suggesting that groundwater situated below the inter-tidal zone constitutes a part of present-day groundwater flow system while the fresh groundwater below sea bottom was separated from the present-day flow system. The coincidence among the apparent residence time of groundwater below sea-bottom, the age of the start of the deposition of marine clay, and the age of the start of the diffusion process strongly suggests that the deposition of marine clay controlled the hydrogeological system and resulted in the reduction of the extent of the groundwater discharge.