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Assessment of mixing processes between groundwater and surface water inferred from strontium isotopes, radon-222, and hydrochemistry in riverside area

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Strontium isotopes, radon-222, and major ion chemistry were used to analyze mixing processes in interaction zones of groundwater and surface water under river stage fluctuations in a riverside area of South Korea. Investigations have been carried out around groundwater heat pump (GWHP) system within a river having island Precambrian gneiss as the bedrock. Environmental tracers were used for quantifying the mixing processes and delineating flow paths between two water bodies. Hydrogeochemical data showed that most groundwater samples were classified as a single chemical type of Ca-HCO_3 and the evaporative signature was found in the water of YSO-10 and YSO-11 wells by plot of δ2H and δ18O and Gibbs diagram. Groundwater samples had relative high ratios of 87Sr/86Sr ranging from 0.7243 to 0.7584, whereas the ratios of surface water were from 0.7197 to 0.7282. The calculated mixing ratio with the linear relationship of 87Sr/86Sr ratio and Sr concentration by two end member model showed high average ratio of surface water as 50.11 percent, representing a strong influence of river water on groundwater. The mixing ratios computed based on radon tracer data also matched well with the results of strontium tracer, suggesting dual tracer approach be useful for quantitative interpretation of the interaction zone. The results of PHREEQC inverse model also indicated that spatio-temporal variation of Sr elements depending on dam discharge and GWHP operation.

KEY WORDS: Mixing Ratio, Flow paths characterization, Interaction zone, Groundwater, Strontium isotopes, Radon-222, Environmental tracer, PHREEQC, inverse geochemical modeling