Application of the multiple isotopes for evaluation of the human impacts on groundwater flow and contamination in the Seoul City

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Subsurface environmental problems such as subsidence due to excessive pumping and groundwater contamination are becoming increasingly recognized in Asian mega cities. In the Seoul City, one of the largest cities in the Asian countries, the groundwater recharge and discharge balance today is relatively stable except some local areas, whereas its quality is urged to be highly degraded. In this presentation, we attempt to compile the previously reported chemical data to understand the situation of the groundwater contamination of the Seoul City. With this background, we also apply the combined isotopes (dD, T, d15N, d18O, d34S, and 87Sr/86Sr) for representative 18 groundwater and river water samples to clarify the general view of present tendency of the groundwater flow and source of the contamination.

The distribution of stable isotopes (dD and d18O) and T data in combined with observed groundwater level illustrates that the recharged groundwater from either surrounding mountainous area or the Han River discharged to the northern-central part of the city, where the subway tunnel pumping is highly concentrated. The data of d34S and d15N values with SO4 and NO3 contents were efficiently used as an indicator of the contamination by human impacts. These isotopes clarified that the contribution of anthropogenic contaminants i.e., industrial and house hold effluents, waste landfills, and fertilizers, are responsible of the enrichments of SO4 (more than 30 ppm) and NO3 (more than 20 ppm) of the groundwater. The 87Sr/86Sr values of the groundwater vary (0.71 to 0.75) in accordance with the host rocks with different origins. Mineral elements such as Ca are suggested to be derived from the vicinity of rocks.

It is concluded that the groundwater under the Seoul City is greatly affected by the complex human activities: transportation of the pollutants along the groundwater flow controlled by subway tunnel pumping, contributing to the degradation of water quality at urbanized area. The degree of the effects of human activity will be shown in more fine-scale through further sampling and monitoring survey. This study clearly demonstrated that the multiple isotopes technique helps us to investigate the mechanism of the degradation of groundwater quality by human impacts under the metropolitan city of the world.