

Reconstruction of local temporal variation on atmospheric sulfur hexafluoride concentration in the Kyoto Basin by multiple environmental tracer and mass transport analyses

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Groundwater is a valuable water resource and understanding groundwater flow regime is indispensable to maintain its quantity and quality at favorable conditions and to achieve its sustainable use. Residence time is an indicator reflecting flow regime of groundwater and various environmental tracers can be used to estimate residence time. Sulfur hexafluoride (SF_6) is one of such dating tracer and is frequently used to estimate residence time of relatively young groundwater. SF_6 residence time is estimated by comparing temporal variation curve of atmospheric SF_6 concentration with concentration obtained from measurement of groundwater sample. Groundwater dating with SF_6 is sometimes difficult in urban areas because of locally elevated atmospheric SF_6 concentration and/or contamination. If local temporal change of atmospheric SF_6 concentration can be reconstructed, and if contaminated samples can be detected, they help to increase accuracy of groundwater dating with SF_6 . Therefore, we tried to estimate local temporal change of atmospheric SF_6 concentration in the Kyoto Basin. Groundwater samples were collected from 47 wells in the basin and concentrations of tritium and SF_6 were determined. Air samples were also collected at three points to reconstruct the variation curve. Additionally, groundwater flow and mass transport analyses were conducted using MODFLOW and MT3DMS. The groundwater flow and mass transport models were calibrated by comparisons with actually measured water levels and tritium concentrations. Several temporal variation curves of local temporal variation on atmospheric SF_6 concentration were considered, and using these curves, mass transport analysis of SF_6 was conducted. Finally, the calculated and actually measured SF_6 concentrations in groundwater were compared and the temporal variation curve with which error between the calculated and measured values was minimum was selected. In the presentation, residence time of groundwater in the Kyoto Basin is presented and plausibility of the selected temporal curve is discussed.

Keywords: Groundwater, Residence time, Sulfur hexafluoride, Tritium, Mass transport analysis