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Trend Analysis for Groundwater Quality at Different Depths for National Groundwater Quality Monitoring Network of Korea

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Continuous groundwater monitoring is necessary to investigate the changes of groundwater quality with time, and trend analysis using a statistical method can be used to evaluate if the changes are significant. While groundwater quality is typically monitored and evaluated at one depth, in many cases groundwater quality can be different with depths; thus it is required that monitoring and assessment of trends of groundwater quality should be performed at different depths.

In this study, we carried out trend analysis for groundwater quality data of National Groundwater Quality Monitoring Network of Korea to investigate the changes of groundwater quality between 2007 and 2013. The monitoring network has wells with different depths at each site, of which screens are located at about 10 m, 30 m, and 80 m. We analyzed three of the groundwater quality parameters that have sufficient time series data: pH, nitrate-nitrogen, and chloride ion. Sen's test, a non-parametric statistical method for trend analysis, was used to determine the linear trend of groundwater quality data. The trend analyses were conducted at different confidence levels (i.e. at 70, 80, 90, 95, and 99 % confidence levels). The results of groundwater monitoring and trend analysis at each location were compared with groundwater quality management standards and were classified to establish a new groundwater quality management framework of Korea. The results were further plotted in a regional scale to identify whether the trends, if any, can be grouped regionally.

The results showed that wells with significant increasing or decreasing trends are far less than wells with no trends, and chloride ion has more wells with significant trends compared to pH and nitrate-nitrogen. The trends were more or less affected by local characteristics rather than reflecting a regional trend. The number of wells with trends decreased as the confidence level increased as expected, indicating that it is necessary to set an appropriate confidence level for the trend analysis to establish a groundwater quality management framework. The results also showed that at some well locations groundwater quality and trends are different with depths, confirming that groundwater quality monitoring and assessment with different depths should be incorporated into a groundwater monitoring system. This study can be used to improve the current groundwater monitoring network and to establish an advanced groundwater quality management framework, particularly in Korea.