

Multivariate geostatistical study on the nitrate contamination in an alluvial aquifer, Osong area, Korea

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In order to understand the spatial control of hydrogeochemical processes relating to nitrate concentrations in alluvial aquifer, multivariate geostatistical approaches were used to hydrochemical data of 45 groundwater samples from Osong area. The mean nitrate concentration of alluvial groundwaters is very high (35.5 mg/L). Thirty-one percent of the samples exceed the Korean Drinking Water Limit (44.3 mg/L). Such high concentration of nitrate, together with enriched SO₄, Ca, Cl, Mg and Na, is caused by intensive agricultural activities in the study area, which result in the hydrochemistry of Ca-Cl(SO₄) type with significant nitrate. In spite of significant agricultural contamination in the study area, nitrate concentration obviously decreases around oxbow lakes in the central parts of alluvial plain, where the groundwater also shows very low levels of Eh but increased Fe and Mn. This pattern indicates that reducing condition is formed around oxbow lakes and redox processes contribute to the decreased nitrate.

Multivariate geostatistical interpretation of collected hydrochemical data yields two factors describing the spatial correlations between hydrochemical variables. Two main hydrochemical processes are proposed to explain the chemistry of each sample: 1) first factor scores indicating the contamination by agricultural chemicals and 2) the second factor scores explaining the redox process. A map showing the distribution of factor scores for each groundwater sample was constructed to show the spatial variability of water quality. The spatial pattern clearly shows that reducing environment is locally developed in alluvial groundwater adjacent to the oxbow lakes and results in denitrification. This study shows that multivariate geostatistical approaches can be effectively used to assess the groundwater pollution and to propose the proper management plans for sustainable development of groundwater in alluviums with active agricultural activities.

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