Paper Number: 1218

Pollution Characteristics of Nitrogen and Isotopic Analysis of Shallow Groundwater in the Sewage Irrigation Areas of Kuihe River, China

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Groundwater pollution by compounds of nitrogen is a serious problem in sewage irrigation area. Prolonged sewage irrigation and use of manure and fertilizers lead to nitrogen pollution of ammonia-N and nitrate-N, such as NO_3^-, NO_2^- and NH_4^+, in shallow groundwater. Investigation on the nitrogen distribution characteristics will be difficult, because of its complicated migration in aquifers and being difficult to remove. In this study, testing samples and isotopic analysis are utilized to understand the pollution characteristics of shallow groundwater in the sewage irrigation areas of Kuihe River, Xuzhou, China.

On both banks of Kuihe River in Xuzhou area, the dominant farming regions are located at 117°12′′E longitude, 34°04′～34°08′ N latitude. The main varieties of plant are rice, wheat and vegetables. Prolonged sewage irrigation lead to serious pollution of shallow groundwater. The test and analysis of shallow groundwater samples, which were collected from boreholes at the two sides of Kuihe River in Xuzhou, demonstrated that the main existence form of nitrogen in the study area was NH_4^+, followed by NO_3^-. Perennial sewage irrigation infiltrating into groundwater through unsaturated zone is an important sources of NH_4^+, although NH_4^+ is adsorbed preferentially by silty clay layer. The isotopic analysis of $\delta^{15}N$-NH_4^+ showed that 27.3% of NH_4^+ in the groundwater was from chemical fertilizer and the remaining was from the sources with high $\delta^{15}N$, such as the animal manure and domestic sewage. The isotopic analysis of $\delta^{15}N$-NO_3^- showed that 15.2% of NO_3^- was from chemical fertilizer and soil organic nitrogen and 63.6% was from animal manure and sewage. The test and analysis of groundwater also showed that about 21.2% of samples were with higher isotope values than the pollution source, reflecting the denitrification in shallow groundwater in the study area.

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