Geophysical Research Abstracts, Vol. 8, 07767, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07767

Residence time and age distribution of nitrate polluted groundwater from a drinking-water catchment in Saxonia, Germany

K. Osenbrück (1), S. Fiedler (2), K. Knöller (1), S.M. Weise (1), J. Sültenfuss (3), H. Oster (4), G. Strauch (2)

(1) Department of Isotope Hydrology, and (2) Department of Hydrogeology, UFZ Centre for Environmental Research, Halle, Germany, (3) Institute of Environmental Physics and Oceanography, University of Bremen, Germany, (4) Trace-Gas-Laboratory Dr. Oster, Wachenheim, Germany

The pollution of major groundwater resources with nitrate from agricultural activities has worldwide raised serious concerns about potentially harmful ecological and human health implications. In many cases groundwaters persistently show high nitrate concentrations despite the considerable efforts undertaken to reduce nitrate leaching from arable soils. Most probably this is due to the long residence times of water and nitrate in the unsaturated zone and the aquifer. Therefore, the residence time and age distribution of groundwater is an important requirement for a reliable prognosis of the development of nutrient loads upon changes in land use or agricultural practices. It was with this aim that we used concentrations of the environmental tracers tritium, He-3, He-4, and CFCs in conjunction with nitrate stable isotopes to estimate the residence time of groundwater from the agriculturally used Jahna-Aue drinking-water catchment in Saxonia, Germany. Current nitrate concentrations in the groundwater of the main well gallery are close to the drinking-water limit of 50 mg/l and supposed to increase further. The production wells, which provide drinking-water for more than 130 000 people, exploit groundwater from the main aquifer comprising of quaternary sands and gravels. The concentrations of tritium and tritiogenic He-3 in groundwater from the main well gallery can consistently be explained by lumped parameter models with high mean residence time between 25 and 50 years, low to medium age dispersion and high contributions of an old, tracer free groundwater. The morphological features of the unsaturated zone as well as the structure and hydraulics of the

quaternary aquifer are reflected in the lateral and depth dependances of the model parameters, suggesting that the results are reasonably in accordance with the main hydrogeological characteristics of the investigated catchment. High residence times are supported by low concentrations of CFCs in most of the production wells and by a correlation with radiogenic He-4 as an independent age indicator. The derived age distribution suggests, that the shallow and therefore most vulnerable part of the aquifer is not connected to the well screens. Deterioration of the groundwater quality with respect to nitrate may occur if the groundwater pumping regime is changed so that the fraction of the younger, nitrate bearing water is increased. In conclusion, the findings show that a sustainable groundwater resource management of the production wells is of equal importance with management strategies to reduce the nitrogen imbalance in the catchment area.