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Tracing the sources and fate of diffuse nitrate contamination in a lowland agricultural catchment using a dual-isotope method

S.K. Wexler, K. M. Hiscock, and P. F. Dennis
School of Environmental Sciences, University of East Anglia, Norwich, Norfolk, U.K. (s.wexler1@uea.ac.uk)

To gain insight into processes affecting nitrogen transport and attenuation in a lowland agricultural catchment in eastern England, the nitrogen and oxygen isotope composition of nitrate was measured using the denitrifier method. Areas of the catchment, the River Wensum in Norfolk, are designated Special Areas of Conservation under the EU Habitats Directive but the river is impacted by point source and diffuse (non-point) pollution from intensive arable agriculture that affects both the underlying Cretaceous Chalk aquifer and the groundwater-dependent river.

In this study, river, tributary, and groundwater samples were collected, together with agricultural, sewage and atmospheric nitrate source samples over a 24-month period during various seasons and flow regimes. Values of delta 15N-NO3 and delta 18O-NO3 from river samples fall within a narrow range, with the composition mainly corresponding to manure, fertiliser and sewage sources. Nitrate from tributary waters shows a broader range of nitrate isotope values which vary in response to flow conditions. There in no evidence of atmospheric source signatures being conserved in the water draining the catchment. The River Wensum displays three distinct sections with respect to trends in nitrate concentration and isotopic composition, which remain stable with changes in seasonal flow regime. A rising trend in nitrate dual-isotope ratios corresponding to a falling trend in nitrate concentration is seen consistently in a 20-km reach of the river. Although the river flow is primarily supported by groundwater baseflow, the nitrate concentration and isotope composition of Chalk groundwater samples do not suggest that these trends are attributable to simple mixing. It appears that significant natural attenuation through denitrification is occurring within the river.