Tracing Groundwater-Surface Water Processes in a Chalk Catchment Using Fluorescence Properties of Dissolved Organic Matter

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1. Introduction

Understanding the hydrochemical functioning of lowland catchments is important for effective environmental management of river and wetland ecosystems. Previously, anthropogenic tracers such as CFCs and SF_6 have been used understanding groundwater flow and mixing processes within a part of the Lambourn Chalk catchment at Boxford (*Gooddy et al., 2006*), one of the Lowland Catchment Research (LOCAR) monitoring sites (Fig. 1). Here we apply the emission excitation spectra obtained from fluorescence spectroscopy to the same catchment study site.

The fluorescence properties of groundwater and surface water samples from the Boxford site have been examined to investigate the use of dissolved organic matter as a natural tracer. In doing this we hope to gain a better understanding of groundwater-surface water interactions as well as the characteristics, sources and biogeochemical process that effect organic matter in this environment.

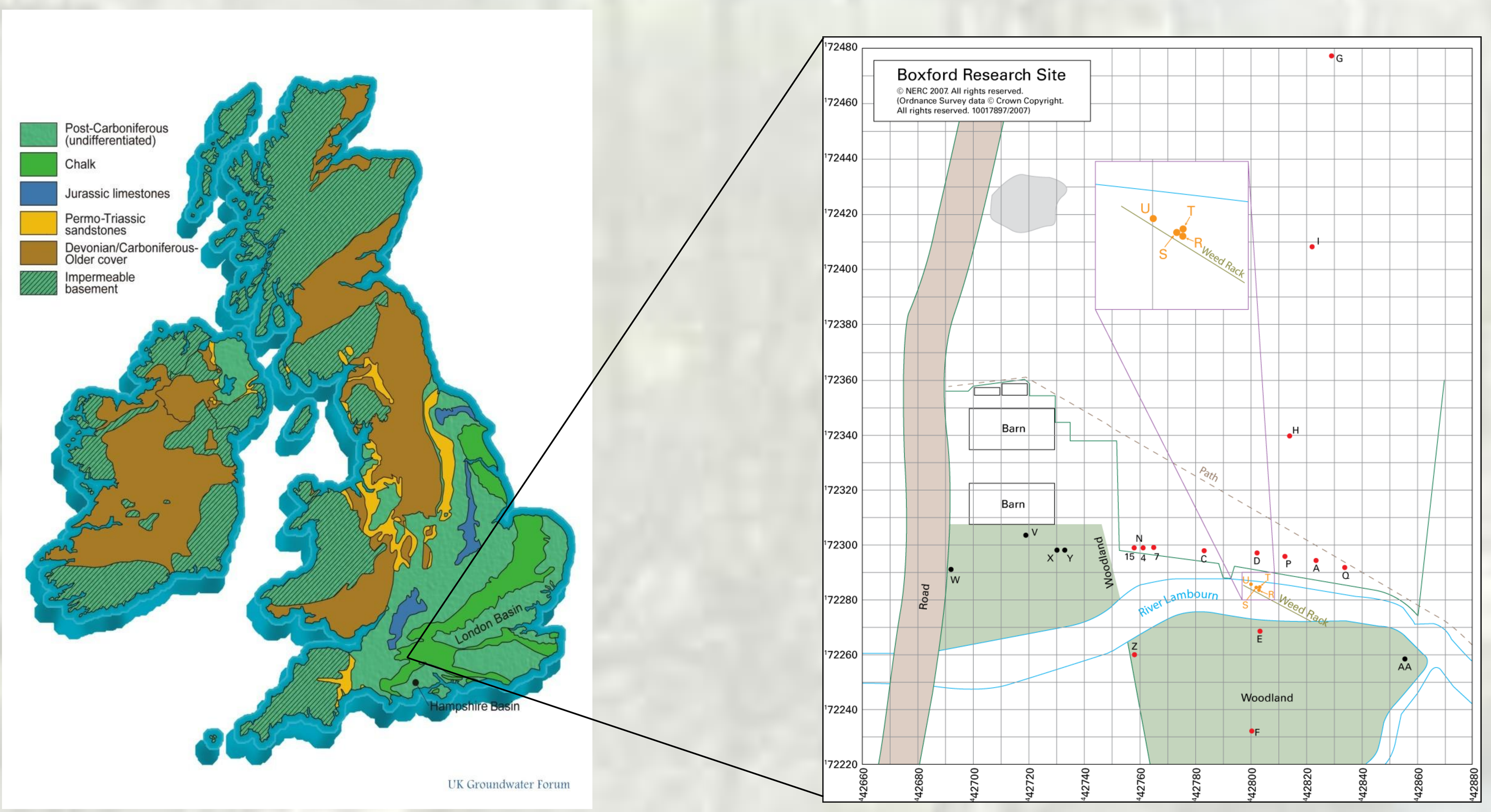

Figure 1. Location of LOCAR research site at Boxford

2. Site description and water sampling

The study site consists of a series of boreholes (Fig. 1) located on either side of the River Lambourn at Boxford. Most of the boreholes contain two piezometers set at different depths. Shallow piezometers in D and E were completed in gravels of the flood plain while A was in a sandy layer. Deeper piezometers were all completed at greater depth in the Chalk aquifer proper.

Groundwater samples were collected from both the shallow and deep piezometers in each of the three boreholes. River samples were collected before and after a sewerage outflow to the east of the borehole array. A sample of the sewage outfall was also collected for comparison.

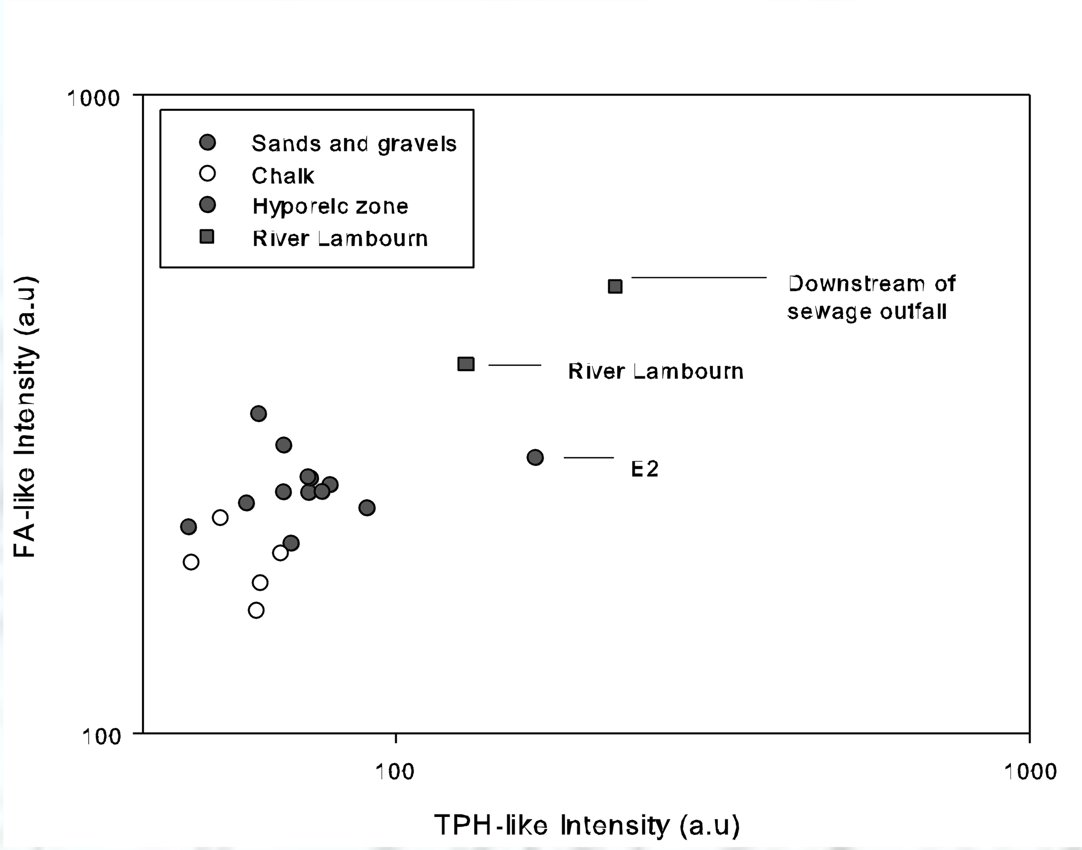

Figure 2. Cross plot of FA-like and Tryptophan-like intensities

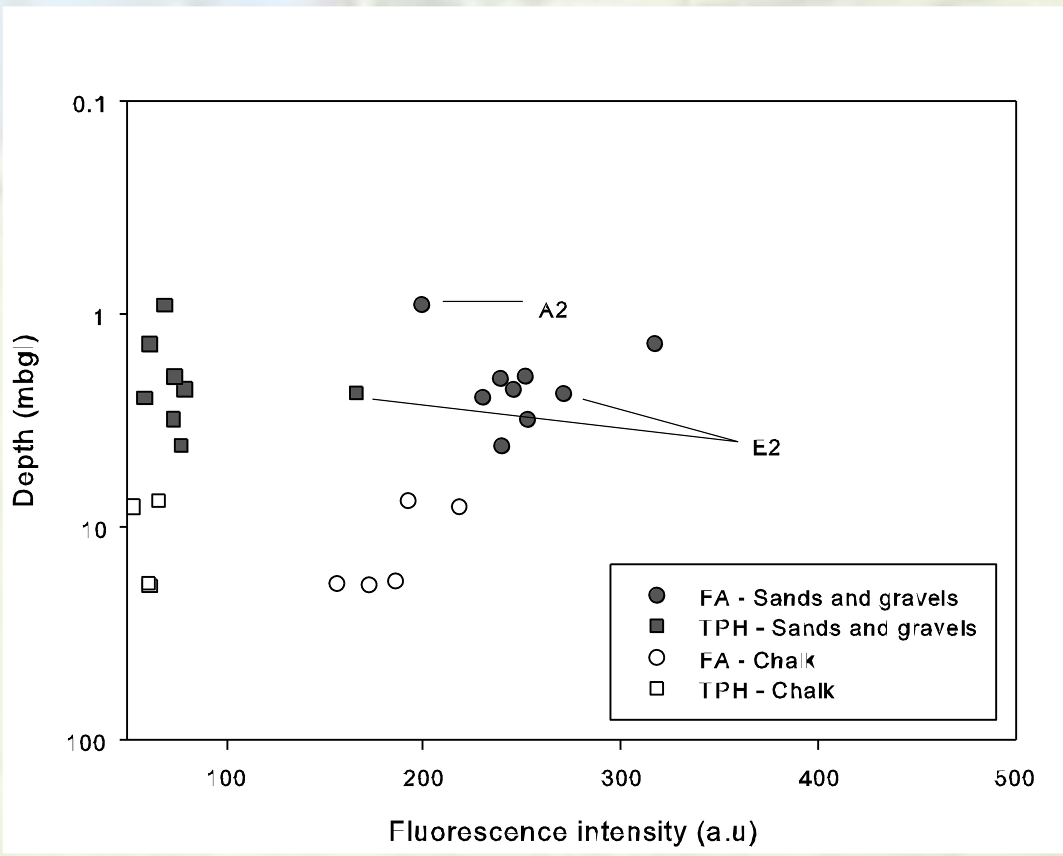

Figure 3. Depth variation in FA-like and tryptophan-like intensities

3. Groundwater-Surface water Interaction

Fig 2 and 3 show the combined use of FA –like and tryptophan –like intensities to understand mixing processes between the two end members, the river and the groundwater system, in the shallow alluvial groundwater.

Fig 4. shows fluorescence centres from groundwater in the gravels adjacent to the river (D and E). They display less of a river signature and are therefore likely to be partially isolated with the river system. Groundwater from the sandy layer (A) and the Chalk beneath the gravels show fluorescence signatures similar, although less intense, to that of the river indicating a degree of mixing between water bodies.

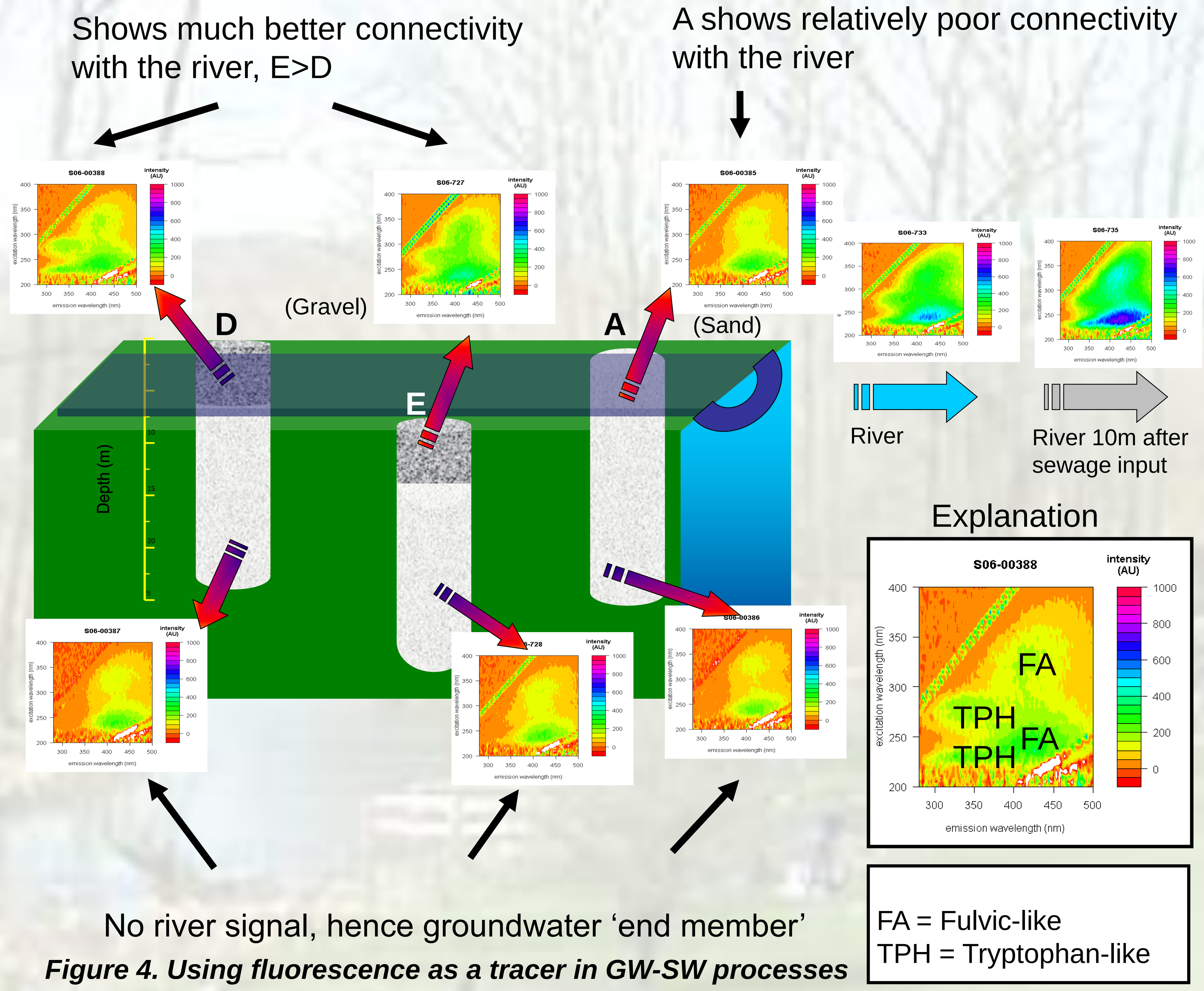

Figure 4. Using fluorescence as a tracer in GW-SW processes

4. Conclusions

This study shows the application of organic matter fluorescence analysis to help understand GW–SW processes in a lowland Chalk groundwater dominated catchment. It highlights the heterogeneity of mixing processes within the riparian zone, sand and gravel deposits adjacent to the river, and shows the spatial extent of GW–SW processes.

The method has potential for use in conjunction with classical techniques (Piezometric head, isotopes and chlorofluorocarbons) for understanding GW-SW processes and may be particularly useful in Chalk GW dominated systems where inorganic chemistry often show little spatial/temporal variation.

Reference: Gooddy et al., 2006. J Hydrology, 330, 44-52.

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