

Investigating groundwater movement and pathogen transport in sandstone aquifers using intrinsic fluorescence spectroscopy

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Introduction

Excitation-emission matrix fluorescence spectroscopy is a natural organic matter characterisation method that can be used to rapidly assess the fluorophoric nature of environmental material. In this study the fluorescence properties of groundwaters from two UK sandstone aquifers were investigated using EEM fluorescence spectroscopy. Figure 1 shows a schematic of common fluorescence peak centres found in environmental samples as well as a EEM from a groundwater sample.

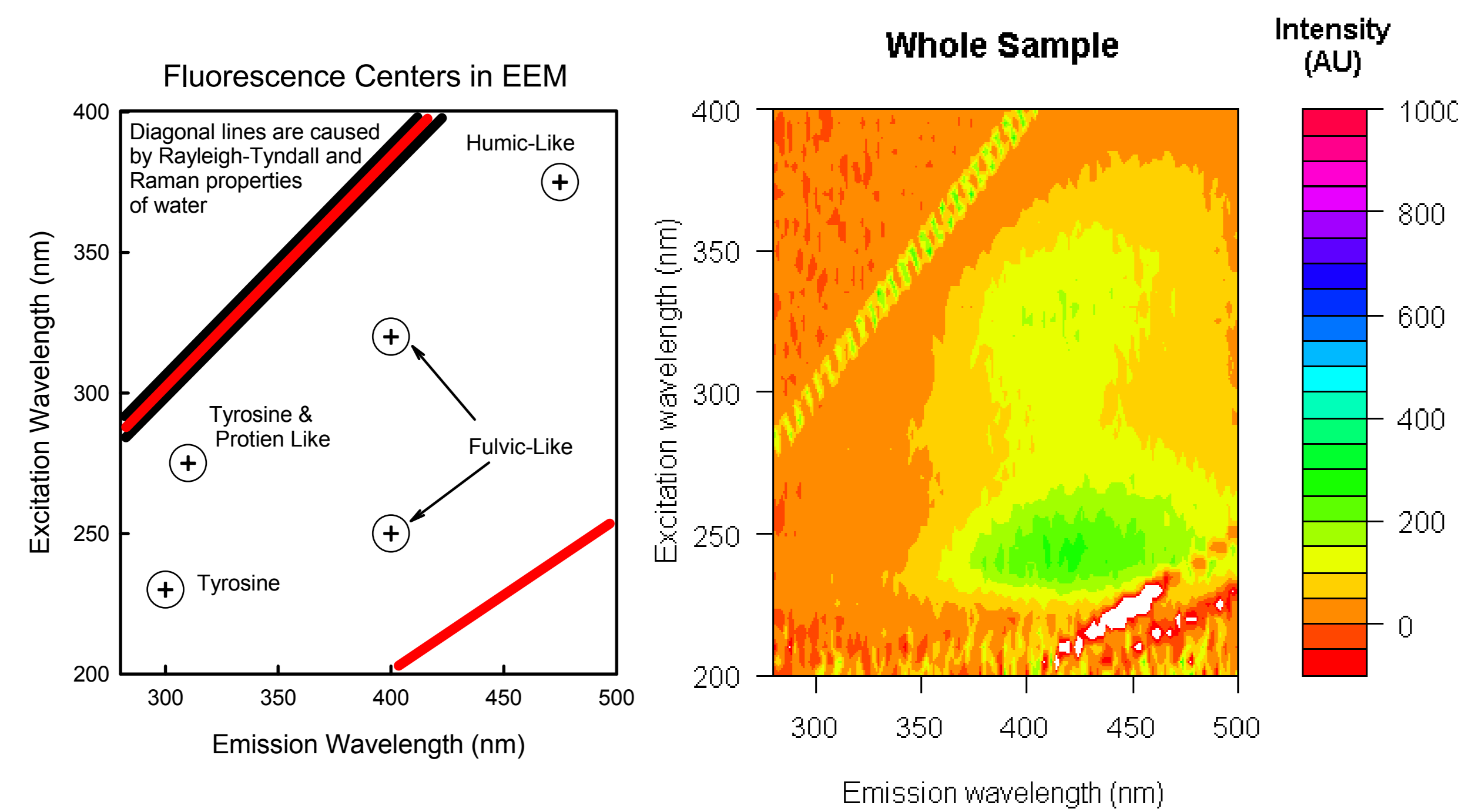


Figure 1. Schematic of EEM and example groundwater sample

Results

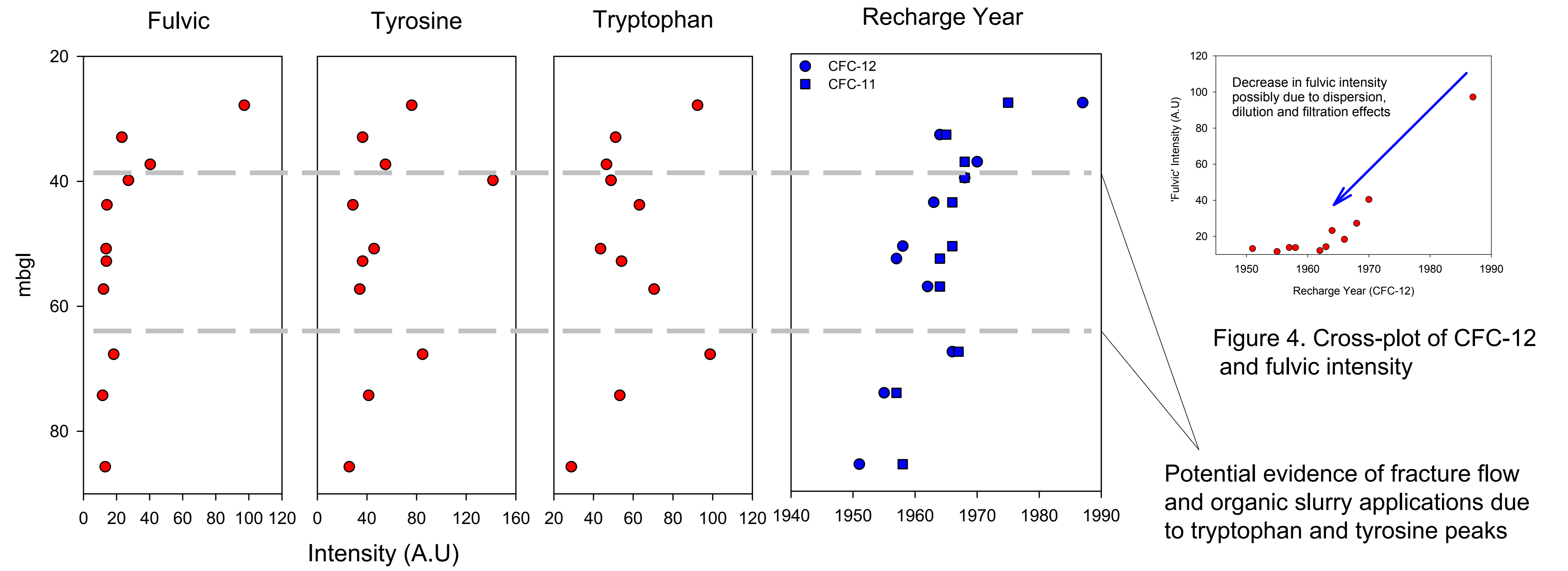


Figure 3. Depth profile of selected fluorophores and recharge year using CFC data in the Penrith Sandstone

Figure 4. Cross-plot of CFC-12 and fulvic intensity

Potential evidence of fracture flow and organic slurry applications due to tryptophan and tyrosine peaks

Study areas

Two study sites were chosen, one in the Penrith Sandstone of Cumbria and one in the Sherwood Sandstone of South Yorkshire. Both aquifers are regionally important sources of public water supply and have contrasting hydrogeological settings: the Penrith Sandstone example being characterised by largely inter-granular flow and the Sherwood Sandstone site having localised rapid routing to depth along fractures and marl bands.

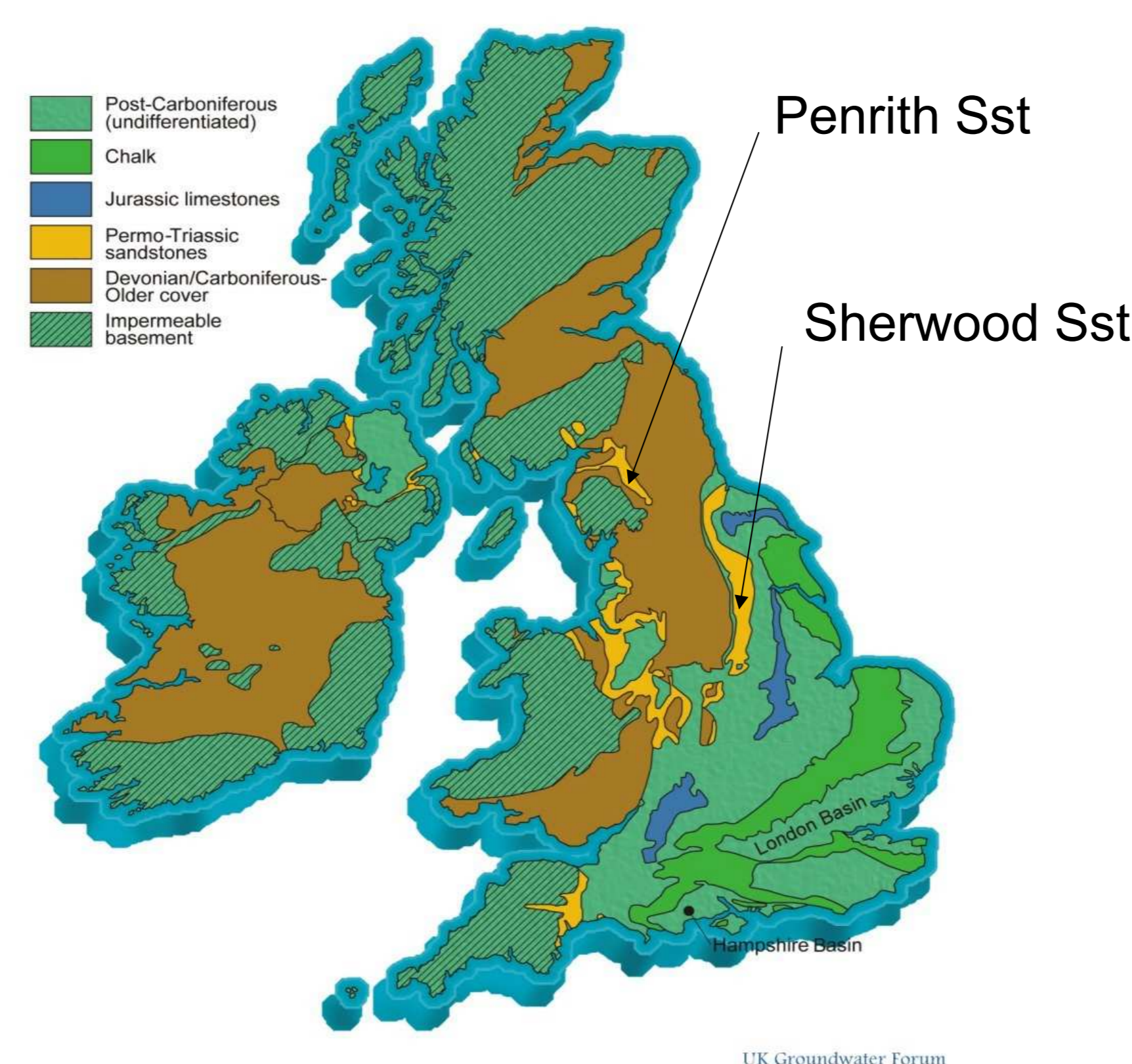


Figure 2. Study sites in Cumbria and S. Yorkshire

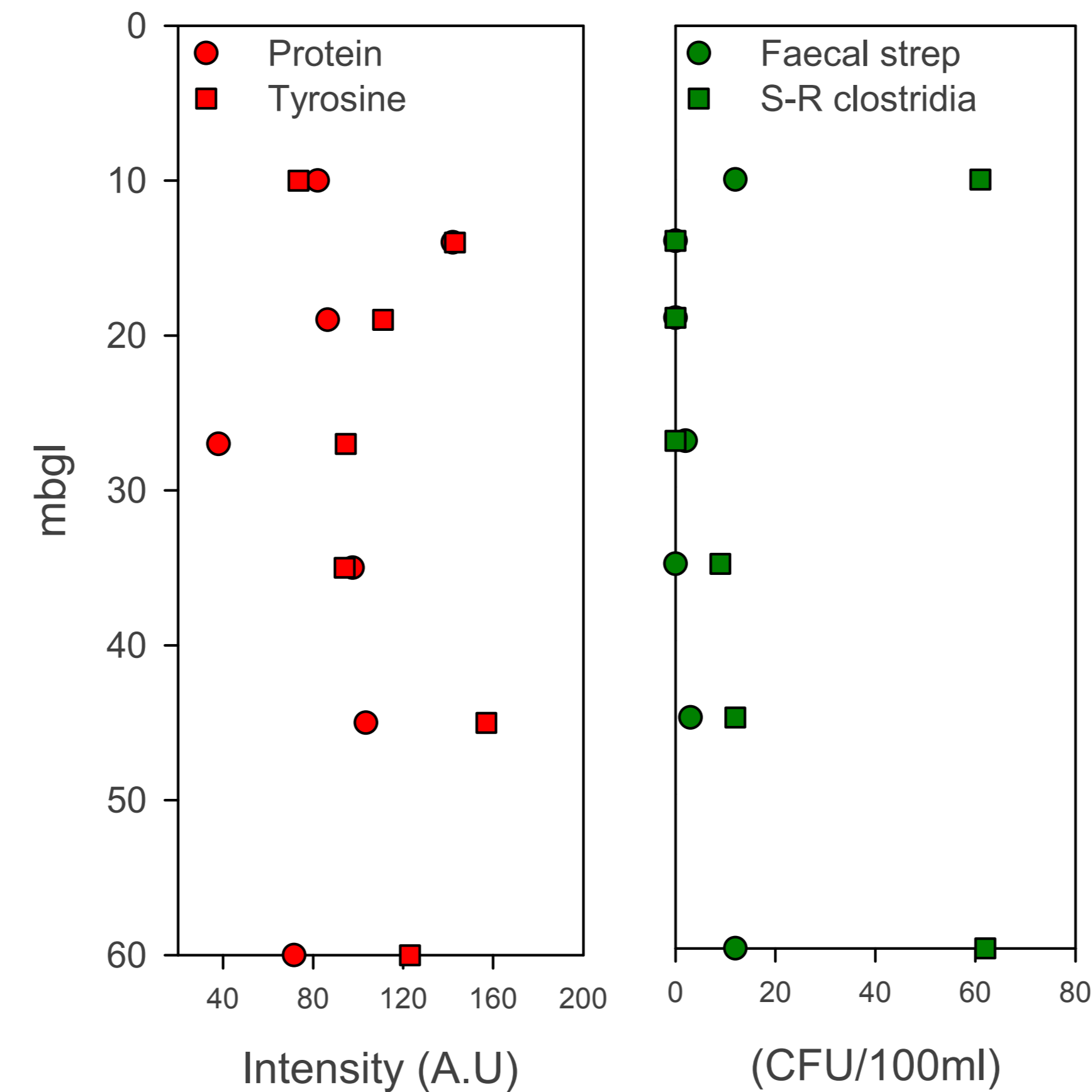


Figure 5. Depth profile of selected fluorophores and microbiological data in the Sherwood Sandstone

Evidence of rapid flow along fractures and marl bands within the Sherwood Sandstone unit. Fluorescence method may be useful as a proxy for microbiological activity

Conclusions

- Fluorescence spectroscopy is a valuable tool to help understand the source and nature of organic carbon in groundwater systems
- It may be possible to use in conjunction with or as a proxy for other methods e.g. CFCs/microbiology to investigate groundwater movement and pollution
- This relatively simple and rapid method has potential as a screening tool for microbial groundwater contamination in the UK and overseas