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Investigating groundwater movement and contaminant transport in two contrasting Sandstone aquifers using intrinsic fluorescence spectroscopy

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The fluorescence properties of groundwaters from two UK aquifers, the Penrith Sandstone of Cumbria and the Sherwood Sandstone of South Yorkshire, were investigated using excitation-emission matrix (EEM) fluorescence spectroscopy. Both aquifers are regionally important sources of public supply water and are locally impacted by anthropogenic pollution. The site in the Penrith Sandstone aquifer is in a rural setting and the Sherwood Sandstone site is in suburban Doncaster. The two study sites have contrasting hydrogeological settings with the Penrith Sandstone being characterised by largely inter-granular flow and the Sherwood sandstone aquifer having localised rapid routing at depth along fractures and marl bands. Fluorescence analysis of samples from discrete sample depths in the Penrith Sandstone showed decreasing “Fulvic-like” intensities with depth and also showed a good correlation with anthropogenic groundwater tracers CFC-12 and CFC-11. Tyrosine and tryptophan centres in the EEM may also show evidence of historical applications of organic slurry. Fluorescence analysis of groundwater sampled from multi-level piezometers installed within the Triassic sandstone aquifer shows regions of protein fluorescence and soluble microbial by-products in the EEM. The fluorescence intensity profile in the piezometers shows tyrosine and protein peaks at depths in excess of 50 metres and mirrors the pattern exhibited by microbial species (faecal Streptococci and S-R Clostridium) and CFCs highlighting the deep and rapid penetration of modern recharge, possibly with a component from urban waste-water recharge. Results from these two studies suggest that intrinsic fluorescence may be used as a proxy for, or complimentary tool to, other groundwater investigation methods in helping provide a conceptual model of ground-

water movement.