

Fluorescence Spectroscopy as an Emerging Measurement Technology for Groundwater OM

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Recent production of bench and field fluorometers, which provide rapid assessment of fluorescent dissolved organic material (FDOM), has enabled measurement of groundwater FDOM to become a cheap and effective tool in the hydro-chemical characterisation of a site. Here we will provide an overview of actual and potential applications of the technology. Measurement techniques include field sensors held in a flow cell while sampling to provide real time data, deployment of sensors in a well for long term logging and bench top instruments which provide excitation emission matrices (EEMs) and absorbance data. Data collected includes both relative fluorescence intensity and absorbance at specified wavelengths. The key to application of fluorescence data collected is identification of common fluorescence intensity peaks. This is achieved through development of a parallel factor analysis (PARAFAC) model. Fluorescence spectroscopy was used to develop a PARAFAC model for the aquifer at the UNSW Wellington research station using 480 collected EEMs. Using a combination of the modelled components and absorbance data at 340 nm, key variations in groundwater FDOM type and concentration at the site have been identified. The identified FDOM sources across the site were: aquifer background; landfill leachate; river infiltration and recharge fluxes through the land surface. Fluorescence spectroscopy has significant potential for application as a tool for groundwater characterisation based on variations in FDOM. Current data collection methods include standalone measurements or coupling with established techniques. Our findings suggest application of these methods can significantly enhance site hydro-chemical characterisation from both contaminated land and groundwater resource aspects. Further development and application of fluorescence spectroscopy will promote methods which can be implemented as common practice benefiting government, research and commercial focused investigations.