FLUORESCENCE QUANTUM YIELD FOR NATURAL ORGANIC MATTER OF SOIL ORIGIN: DEPENDENCE ON EXCITATION WAVELENGTH

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Natural organic matter (NOM) is present in all types of natural water and soil and plays a significant role in their biogeochemistry and optical properties (1). Absorbance and fluorescence spectroscopy are economical tools for tracing the supply, turnover and fate of NOM (2). The main fluorescence characteristics like an excitation/emission maximum wavelengths and fluorescence quantum yield (QY) can provide the key information about NOM structure and sources.

The objective of this work was to study correlation between fluorescence QY and excitation wavelength for whole soil origin NOM from different sources (chernozem KHA, podzol PHA, Elliott EHA -IHSS standard 1S102H) and its fractions A, B and C+D, obtained by size exclusion chromatography–polyacrylamide gel electrophoresis setup for which the nominal molecular size (NMS) varied in the order A>B>C+D>10kDa (3). Fluorescence emission spectra were registered for different excitation wavelengths in the range 250 – 600 nm with the step 10 nm. The fluorescence QY was determined using a solution of sulphate quinine as a fluorescence QY reference.

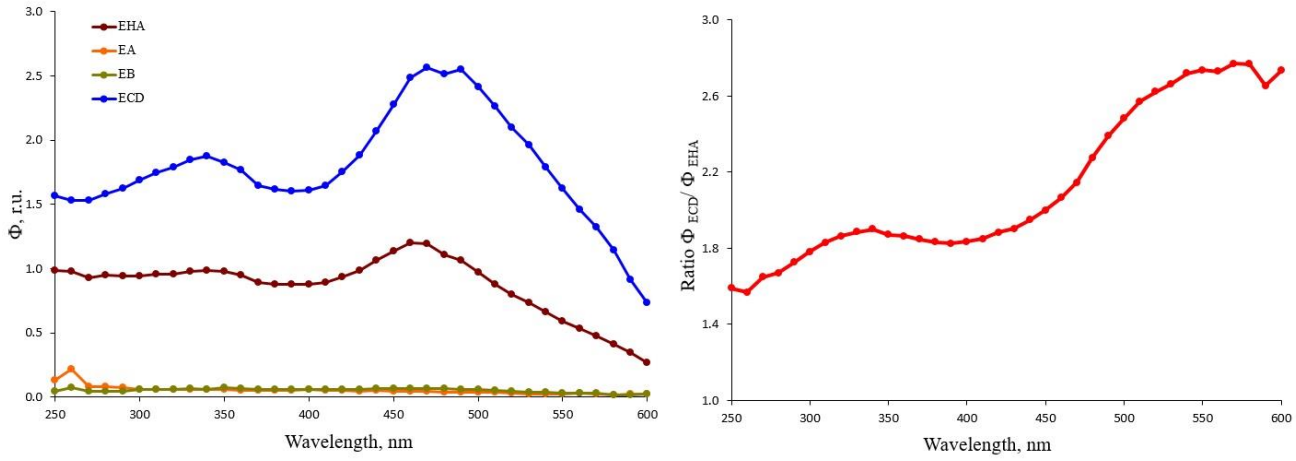

Figure 1: a) Fluorescence quantum yield dependence on excitation wavelength for Eliot soil humic acid and its fractions; b) Dependence of the ratio Φ_{ECD}/Φ_{EHA} on excitation wavelength.

Our studies revealed that the behaviour of the fluorescence QY of all investigated samples and its fractions was similar. It was shown that the protein-like fluorescence was almost exclusively located in high molecular size fraction A and medium molecular size fraction B with the small value of QY (Figure 1a). Due to the fact, that fractions A and B had very small humic-like fluorescence, no dependence of the quantum yield on the excitation wavelength was observed. In contrast

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fluorescence QY of bulk soil humic acids (Φ_{HA}) and its C+D fractions (Φ_{CD}) depends on excitation wavelength: increase from excitation wavelength 250 nm to a maximum at wavelength excitation around 470-480 nm and decrease monotonically after, but the fraction C+D with the smallest molecular size had the highest value of QY. Interestingly, the ratio Φ_{CD}/Φ_{HA} also depends on excitation wavelength. For example, for Elliott soil it varies from 1,5 (λ_{ex}=250 nm) to 2,5 (λ_{ex}=500 nm) (Figure 1b). The values of the fluorescence QY at a maximum (λex=470 nm) varied in the order $\Phi_{PCD}>\Phi_{KCD}>\Phi_{ECD}$ for C+D faction, and for bulk soil humic acid $\Phi_{KHA}>\Phi_{PHA}>\Phi_{EHA}$, respectively.

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