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Organic matter humification and trace element accumulation in raised bogs depending on the peat properties

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In the carbon biogeochemical cycle of key importance is the transformation of living organic matter into refractory part of organic matter - humic substances – humification. Both degradation and synthetic processes during decay of living organic matter are described as humification and in general it describes transformation of numerous groups of substances (proteins, carbohydrates, lipids etc.) and individual molecules present in living organic matter into groups of substances with similar properties (humic substances). The aim of this study is to analyse relations between the peat properties, humification degree and trace element accumulation on example of analysis of peat profiles in ombrotrophic bogs in Latvia.
We have studied peat properties in bogs of similar age, located spatially closely, but with very much differing peat column stratigraphy and peat column botanical composition as well as decomposition degree. Basic peat properties was analysed using peat elemental (C, H, N, O, S) composition. It has been found that the elemental composition of peat is comparatively variable and reflect the changes in the peat decomposition degree and peat type. Much more informative than elemental composition of peat is elemental ratio. The peat formation process was examined using van Krevelen graphs frequently applied for the analysis of carbon biogeochemical cycle and genesis of fossil fuel. The atomic ratios O/C, H/C, and N/C indices are useful in the identification of structural changes and the degree of maturity of peat in different depositional environments and reveals changes in the properties associated with coalification reactions.
Spectral analysis both of intact peat both of peat alkaline extracts largely confirms the before mentioned conclusions, but allows to identify the structural and molecular features ongoing during humification process. The UV and fluorescence spectra allows to study development of aromatic structures during humification process.
Absorption at 540 nm in the Vis spectra of peat alkaline extracts can be used as an simple indicator of humification process. This humification index demonstrates expected differences and the changes can be associated both with the peat decomposition degree, both with the differences in peat composition.
Better quantification of aromaticity during humification proves fluorescence spectra where two well expressed peaks can be observed, one of them (490 - 520 nm) clearly associated with aromaticity of the studied material. The ratios of the fluorescence intensities at different wavelengths can be used as humification indicators and in this study we tested possibilities to use fluorescence intensities. The changes in the character of FTIR spectra show the character of changes in the intensity of functional groups with peat material humification (increasing age, depth and decomposition degree). The changes in the functional groups of the peat organic material at first can be related to relative amounts of –OH, -COOH, -C=O, CH groups.
Trace element accumulation character in the peat reflects the recent pollution impacts as well as accumulation of elements coming from minerals forming bog bed.
As it has been found in this study the transformation process can be described using multiproxy analysis of peat elemental composition, elemental ratios and spectral characterization of the peat organic matter and peat alkaline extracts. This approach allows to suggest a three layer structure of bogs indicating recent (largely human induced) processes, dominance of background level impacts and accumulation of elements of natural origin.
Key words: peat, Latvia, humification indicators, multiproxy study