



Influence of water table changes on peat features and humification processes

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Peatland ecosystems play an important role in the carbon cycle. In their natural state, they have been shown to be net sinks for atmospheric carbon dioxide (CO₂) and net sources of greenhouse gases on a long term basis. Peatlands could provide a significant positive feedback for climate change. Unfortunately, drainage of peatlands for forestry, agriculture and/or peat extraction for energy is a common practice in several countries (e.g., the Fenno-Scandinavian region, Canada and Russia). When they are drained, peatland areas become a threat to the environment as the thickness of the aerobic layer increases. This leads to an increase in the rate of organic matter (OM) decomposition and, as a result, peatlands might change from a net carbon sink to a large carbon source, thus resulting in an increase of CO₂ and methane (CH₄) emissions from these organic soils.

In order to better understand hydrological, physical and chemical changes occurring as result of water table level changes, we studied the OM evolution of bulk peat and its humified fraction in undisturbed condition.

A 81 cm peat core was collected from Etang de la Gruère, a Swiss ombrotrophic bog in the Jura Mountains, and humic acids (HA) isolated. Both bulk peat and HA samples were characterized using several molecular spectroscopic methods (Ft-IR, UV-Vis, DSC, Fluorescence) and elemental analysis (CHNS-O).

In general, Ft-IR, UV-Vis and fluorescence results suggest significant variations of the molecular composition and chemical structures of the peat samples along the profile. In detail, the superficial zone (from the living layer to approximately 24 cm) is characterized by oxidative processes and decomposition phenomena of plant tissues and residues continuously occurring in the top horizons of the peat, leading to the release of variable amounts of organic acids and small molecular mass compounds. This section is poorly decomposed. The HA fraction accounts for 6.6 to 15.4% of the bulk peat, thus meaning that only ca. 7.8-17.3% (13.9%, average value) of total C present in peat is stored in the recalcitrant and stable HA fraction, and thus most of the C stock can be easily mineralized.

On the opposite, the bottom zone (under 39 cm depth), in which molecules with high molar mass and high degree of condensation are observed, seems more homogeneous and reflects a peat zone apparently characterized by uniform and permanent anoxic conditions. Here, an obligate anaerobic microbial community can carry out only a partial and slow decomposition of the OM. In this section of the profile, the HA fraction accounts for ca. 20.0-32.7% of the bulk peat, representing ca. 25.1-37.1% (28.6%, average value) of total C present in peat is stored in the HA fraction.

But the variability in the depth of the water table level, providing temporary oxygen diffusion even at greater depth, originated also a "transitional" zone, from about 24–39 cm. Here, changes between aerobic and anaerobic conditions activated microbially induced humification and transformation processes of polysaccharidic and lignin-derived residues, as well as very complex interactions between organic and inorganic compounds. This section, in fact, was characterized by the highest ash content (4.9%, average value) and, if compared with the deeper layer and part of the upper one, by the occurrence of less humified molecules. In this part of the profile, the HA fraction represents ca. 24.3% (average value) of total C present in bulk peat.

In conclusion, and always considering that this study is just a photo of a particular moment, our data suggested that, although a relevant portion of C is stored into the HA fraction, the fluctuations of the water table could favour the temporal exposition of these macromolecules to the microbial activity, thus transforming a stable C pool into a labile one.