

Two factors defining humus as a key structural component of soil organic matter and as a physicochemical speciation of carbon in its turnover wending its way through the micro environment of soil, sediments and natural waters

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Over the last 40-50 years, the scientific community started to question the model of soil organic matter. Close consideration has been given to the following models: the classic model that regards a significant part of soil organic matter as large, covalently bonded 'humus polymers', which are formed via "humification", and the continuum model that considers soil organic matter as 'supra molecular aggregates of degradation fragments' [1]. The underlying cause of a contradiction between 'humus polymers' model and continuum model of SOM implies that 'the vast majority of operationally defined humic material in soils is a very complex mixture of microbial and plant biopolymers and their degradation products but not a distinct chemical category'. Furthermore, authors [1] of the continuum model suggested 'to turn to modern, evidence based concept, and to abandon the operational proxies of the past' that means to consider term 'humus' as an out-of-date model.

However, micro cosmos of organic matter in soil implies not only an assemblage of molecular units but also a system of interactions of different types [2]. Peculiar interactions in SOM allow us to understand a lot of physicochemical phenomena observed in soil samples, for example by EPR and SL EPR examinations [3, 4, 5]. Among specific interactions in soil, mention should be made of hydrogen (H) bonds and hydrophobic interaction. Spin Labeling EPR examination of natural and labeled soil samples showed that in SOM, there are stable and roaming H-bonds. Stable H-bonds are typical of a part of SOM, which can be isolated as humus, whereas a non-humified part of SOM is rich in roaming hydrogen bonds. Addition of some water (more than maximal moisture) to soil leads to disintegration of some weak H-bond. Other solvents influence SOM the same way but they disintegrate stronger or weaker H-bonds in dependence on used solvent. Thus in soil, different environmental conditions (like moisture, temperature or pollution) influence on a change in the partitioning of roaming H-bonds, and in turn, define components, into which non-humified SOM can be disintegrated. Therefore, some physicochemical species of SOM, which can be observed in physicochemical processes of carbon turnover in soil, originate from disintegrated SOM bulged at the seams of weak H-bonds, and doesn't reveal strong properties of humus because humus structure is still bound to SOM via stronger H-bonds. Also, SL EPR examination of native and labeled soil samples revealed the substantial influence of hydrophobic interaction on physicochemical speciation of carbon in soil, and this interaction is mediated by humus [3]. Among different effects of hydrophobic interaction, the formation of condensed matter is of great interest. Condensed matter mediated by humic acids is shown to reveal specific quantum properties and invoke hydrodynamic instability on the surface of plant roots that results in uptake of the whole nano-pieces of humus by plant roots, as it was observed in [6, 7]. Considered effects of H-bonds with different bonding energy and hydrophobic interaction in SOM show that a carbon turnover in soil is mediated by humus, and humus play a substantial role as the physicochemical speciation in carbon turnover. Thus, model of 'humus' is still an up-to-date model.

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