Membrane fractionation of water-extractable organic matter of typical chernozem

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Soil organic matter (SOM) is a highly heterogeneous and heterophase complex system comprising high-molecular, low-molecular, and colloidal particles. Membrane filtration is a promising fractionation method to simplify this system. It allows studying particles ranging in size from 10 Da to several hundred micrometers [1]. Nowadays, there is a growing interest in using this separation method for organic matter, predominantly dissolved organic matter (DOM) of water.

This study used cascade filtration through track-etched membranes with pore size from 0.2 to 5 μm to fractionate water-extractable organic matter (WEOM) from typical chernozem obtained at room temperature and by 80 °C water extraction. By definition, soil WEOM is the DOM obtained by extracting a given mass or volume of soil with an aqueous solution [2]. The filter cut-off used is somewhat arbitrary, but 0.4 to 0.6 μm pore size is usually considered the boundary between dissolved and particulate materials [2]. Thus, membrane filters with the specified pore size used in this work covered not only dissolved but also particulate material. The main focus of the work was on narrow fractions obtained by washout from the corresponding membrane filters.

Based on an analysis of fractions, it was found that fractions differ significantly from each other both in organic and mineral constituents. According to element analysis, element ratios vary significantly between fractions for both macro- and microelements. Al, Fe, and Ti are primarily observed in the fractions with particle size larger than 0.2 μm , while Ba, Mn, Si, Zn, Ca, K, S, and Mg, to a more significant extent are linked with particles of less than 0.2 μm . By fluorescence spectrometry, we found that all fractions contain intensively fluorescing organic components with changing compositions, in particular humic-like and tyrosine-like substances. All obtained fractions contain clay minerals with also changing compositions. Thus, organic matter of different compositions is sorbed on clay minerals of different compositions. Thus, the developed method represents a new approach to isolating WEOM fractions preparatively and expands knowledge about WEOM chemical composition and its relationship with the mineral phase. In the future, we plan to continue fractionation using membrane filters with smaller pore sizes to isolate soil WEOM fractions.

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