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Surface features of soil particles of three types of soils under different land use strategies

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Nowadays, there is a clear need in a deep investigation of molecular composition of soils and of its influence on surface characteristics of soil particles. The aim of this study is to evaluate the composition and properties of physical fractions in different soil types in determining functional specificity of soil solid-phase surface.

The experiments were carried out with three different types of Russian soils—Sod-Podzolic, Chestnut, and Chernozem soils—under various treatments (fallow, different doses of mineral fertilizers and their aftereffects). The samples were separated into three fractions: silt (SF) with a particle size of <2 μm, light fraction (LF) with a density of <2 g/cm3, and residual fraction (RF) with a size >2 μm and the density >2 g/cm3. We measured specific surface area, surface hydrophobicity (contact angle, CA), ζ-potential, and the point of zero charge (PZC).

For Chernozem and Chestnut soils and their fractions of we observed an increase in hydrophobicity for SF and RF under fertilizer treatment. At the sites not treated with fertilizers and aftereffect sites, the hydrophobicity of fractions was lower compared to the sites under treatment. The CA of the original soils and fractions were different: in 35% of cases CA was higher for SF and RF by 12-16%. The rest of samples demonstrated CA of all three physical fractions lower than CA of the original soil. The variability of the mean CA indicates considerable differences in ζ-potential and PZC between different types of soils and soil fractions.

The results of potentiometric titration of PZC for Sod-Podzolic soil showed that all values are in acidic range, which suggests predominance of acidic functional groups at the surface of soil particles. Specific surface area determines soil sorption processes, bioavailability of nutrients, water etc. Here, specific surface area of Sod-Podzolic soil was low and SF-dependent.

We calculated specific surface charge from obtained data on specific surface area and PZC. The results suggested considerable differences between sorption features of both soils and fractions under different land use strategies.