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Changes in soil surface fractal dimension due to accumulation of soil organic matter as resulting from the analysis of water vapor adsorption isotherms

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The objective of this work is to perform studies aiming at the investigations of the dependence between the content of organic matter and the surface fractal dimension of samples. The values of the surface fractal dimension are calculated from the adsorption isotherms of water vapor. We start with the studies of model systems, containing controlled amount of organic matter. Two basically different approaches have been used to develop such systems. One involves the gradual removal of the humus from the soil, and comparative investigation of the residual samples. The other is to model interactions between purified inorganic and organic soil constituents by using special techniques, which simulate the formation of humic coatings on clay surfaces in the laboratory. We have applied the second method below and report the results of investigation of samples of kaolin and quartz modified by addition of different amount of humic acid (HA). Moreover, we have also studied controlled systems obtained by mechanical mixing sandy soil with peat and by adding a known amount of compost to soil. The studies of controlled systems should be helpful to establish trends on both the specific surface area and the surface fractal dimension as functions of the organic matter content. Then, we proceed to study more complex systems. We study peats, forest humuses and brown coal from mines.

The aim of the investigations of controlled systems was to discover some general trends in the dependencies of the specific surface area and the surface fractal dimension on the content of organic matter. Let us summarize briefly our findings. It was demonstrated that the amount of organic matter influences the geometric heterogeneity of the investigated samples but, in general, the existence of a linear relationship between the content of organic matter and the surface fractal dimension, D, seems to be an exception rather than a rule. The linear correlations do exists if the samples are produced by mixing components containing a small amount of organic material with the samples rich in organic carbon (e.g. with peat). If the interactions between the mixed components are weak, then the plot of D vs. the amount of the organic matter can be modelled by a straight line. However, in the case of more pronounced interactions, the dependence of D on the amount of organic matter becomes more complex.