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Characterization of the humic substances isolated from postfire soils of scotch pine forest in Togljatty city, Samara region by the 13C-NMR spectroscopy

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Postpyrogenic soil dynamics is an informative tool for studying of soil elementary processes in extreme temperature conditions and for predicting of short time environmental changes in conditions of catastrophic landscape changes. Soil organic matter (SOM) system evolution is the most rapid process of postpyrogenic soil development. In this relation the evaluation of humus accumulation rates and humification trend were conducted with use of the classical chemical and modern spectroscopy methods. Soil restoration after spontaneous forest fires near Togljatty city (Samara region, Russia) was abandoned in 2010, and further monitoring over the next four years was organized to evaluate the speed of biogenic processes and humus accumulation dynamics.

Three key soil plots were studied for estimating SOM quality changes under the forest fire effect: surface forest fire, crown forest fire and control. Total carbon and nitrogen content as well as Cha/Cfa ratios (content of humic acids/ content of fulvic acids), were estimated to assess the dynamics of soil restoration. Humic acid powders were extracted and analyzed by elemental composition and 13C-NMR spectroscopy to assess changes in humic substance structure and composition.

The data obtained indicate that burning of a forest floor and sod (humic) horizon led to humus losses and decreases in total carbon stocks. As a result of the fires, the content of humic acids in the pyrogenic horizon increased, leading alterations of humus type. Greater increases in the degree of organic matter humification were observed for surface fires than crown fires.

It was shown that the humus molecular composition was substantially affected by the wildfires. The data show an increase in aromaticity, a loss of oxygen-containing groups and dehydrogenation of humic acids. Humic acids in the soils of the control plots and after wildfires were significantly different, especially in the ratios of hydrogen, oxygen and carbon. The increase in the degree of humic acid aromatization was confirmed by the hydrogen/carbon ratio. Investigation of the humic acids' molecular structure by 13C-NMR showed a relative increase in aromatic compounds and decrease in aliphatic ones. In general, crown and surface fires plots are not very different in terms of 13C-NMR spectra of humic acids, however humic acids of control plot have essential differences from pyrogenic ones.

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