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Soil organic matter in soils of the Russian Arctic: insights from 13C-NMR spectroscopy

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Polar soils play a key role in global carbon circulation and stabilization as they contain maximum stocks of soil organic matter (SOM) within the whole pedosphere. Cold climate and active layer dynamics result in the stabilization of essential amounts of organic matter in soils, biosediments, and grounds of the polar biome. Chemical composition of soil organic carbon (SOC) determines its decomposability and may affect soil organic matter stabilization (SOM) rate (Beyer, 1995). This is quite important for understanding variability in SOC pools and stabilization rate in context of changes in plant cover or climate (Rossi et al. 2016). ^{13}C nuclear magnetic resonance spectroscopy, which provides detailed information on diversity of structural composition of humic acids and SOM, may also be used to study the SOM dynamics under decomposition and humification proceses (Kogel-Knabner, 1997; Zech et al., 1997). This study aims to characterize molecular organization of the humic acids, isolated from various permafrost-affected soils of Yamal region and to assess the potential vulnerability of soils organic matter in context of possible mineralization processes. Organic carbon stocks for studied area were 7.85 ± 2.24 kg m-2 (for 0-10 cm layer), 14.97 ± 5.53 kg m-2 (for 0-30 cm), 23.99 ± 8.00 kg m-2 (for 0-100 cm). Results of solid-state 13C-NMR spectrometry showed low amounts of aromatic components in studied soils. All studied humic powders are characterized by predominance of aliphatic structures, and also carbohydrates, polysaccharides, ethers and amino acids. High content of aliphatic fragments in studied humic acids shows their similarity fulvic acids. Low level of aromaticity reflects the accumulation in soil of lowly decomposed organic matter due to cold temperatures. Our results provide further evidence of high vulnerability and sensitivity of permafrost-affected soils organic matter to Arctic warming. Consequently, these soils may play a crucial role in global carbon balance under effects of climate warming.