Stabilization of soil organic matter and development microbial community in chronoseries of soils formation of south taiga ecosystem (bars of Ladoga Lake, Russian North-West)

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This abstract presents the result of the studies of soil formation on the different aged coastal bars in transgression zone of the Ladoga Lake in the Nizhnesvirsky Nature Reserve (Leningrad region, North-West of Russian Federation). The Ladoga Holocene transgression is one of the most informative and applicable models for pedogenesis, successional processes occurring in young and mature areas can be traced here. Local processes of soil formation such as podsolization, gleyfication, peat formation and humus accumulation were identified. Physical, physic-chemical and biological soil properties with a detailed description of the morphology of soil of different aged coastal bars are presented. The investigation presents the data on the soil chronoseries, located on the four Ladoga coastal bars with different ages from 70±25 to 1590±25 years BP. The trends of accumulation and transformation of organic matter, elemental composition of humic acids (HAs), development of plant communities and the influence of the soil formation factors on the rate of formation of soil horizons were estimated. The degree of soils organic matter stabilization has been assessed with the use of modern instrumental methods (spectroscopy of nuclear magnetic resonance (CP/MAS 13C-NMR). Analysis of the molecular composition of HAs showed that aliphatic groups accumulate in the soils. This is due to the high level of hydromorphic in this environment. Due to evolution of podzols, aliphatic groups and the accumulation of humic substances in the soil are increased, with increase of aliphatic groups in molecular composition of HAs it makes HAs more aggressive and leads to increase migration ability. The molecular composition of HAs of young soils is enriched with aromatic fragments and oxygen-containing functional groups, which ensures their high thermodynamic stability. Also the taxonomy composition of microbial communities of different-aged soil has been investigated. Different groups of microorganisms are considered as responsible drivers of various soil formation processes. Copiotrophic microorganisms (belonging to Proteobacteria, Actinobacteria and Bacteroidetes phyla) dominated in microbial communities of the topsoil (organic) horizons. Podzolic (E) horizons were characterized by the increased abundance of Mycobacterium sp. (Actinobacteria). In deeper horizons, the percentage of copiotrophic bacterial groups decreased providing the growth of oligotrophs, as well as archaeal lineages. The deepest (gleyic, G) horizons were characterized by the presence of anaerobic, methane-producing, bacteria.

Thus, the connection between microbial community structure and the continuous development of the soil profile was revealed. The change in physic-chemical parameters was the key driving factor causing the adaptation of the prokaryotic community. The older coastal bar expressed the clearer signs of podzol formation, the greater thickness of the E horizon, and the more obvious dissimilarity between the microbiomes in different genetic horizons. This indicates that microbial community can be considered as a driving mechanism, which regulates solum vertical differentiation within the time of podzol ontogenesis.

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