

Lipid biomarkers under broad-leaved forest plant community as the proxies for the revealing stabilization mechanisms of the humino-mineral soil matrix

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doi: 10.36291/HIT.2019.bazhanova.057

n-Alkanes attribute among the most hydrophobic organic molecules of soil lipid fraction that allows them to be associate with an organo-mineral matrix forming resistant complexes. n-Methyl ketones are produced during first steps of n-alkanes degradation. Annual dynamic of main alkane homologues ratios – CPI, OEP, LSR, calculated for soil density fractions allows to estimate the nature of the organo-mineral associations in the natural systems should not only open up a new road towards improved understanding of organic C and N dynamics in soils and sediments, but also facilitate the modeling of the fate and transport of contaminants [1].

The test plot was selected under lime tree plant community where typical Albic Retisols are developed. Sampling was made from leaf litter, roots of topsoil, soil of horizons AY, AYel, EL, BT, twice in autumn and once in summer. Soil density separation was performed using flotation method in heavy liquid ZnCl₂ ($\rho = 1.60 \text{ g cm}^{-3}$), the two fractions was separated – the free light fraction and the heavy one. In these samples total C and N concentrations were determined with a CHNS analyzer (Elementar). Lipid components were extracted by the method of pressurized fluid extraction in ASE 200 (Dionex). Sample purification and fractionation were carried out in an adsorption column with aluminum oxide. The qualitative identification and quantitative determination of target components were performed by GC/MS Agilent 6890N (Agilent Technologies) with a quadrupole mass-selective detector MSD5973N (Agilent Technologies).

The relative content of n-alkanes in SOM increases for the bulk samples down the soil profile up to 2 times and reaches maximum quantity in the EL horizon -725 $\mu\text{g/gC}_{\text{org}}$. Analysis showed significant seasonal changes in the content and compositions of n-alkanes. In summer their amount in light fraction is about 1-2% of total carbon, and increased up to 4-8% during the autumn. n-Alkane content increases from 195,3 to 360,6 $\mu\text{g/gC}$ in bulk soil with the dominance in the upper part of the profile of long-chain plant origin alkanes (C₂₇, C₂₉) and an increase of the part related to medium-chain in underlying horizons as a result of a greater contribution of bacterial biomass (LSR increases from 8.5 to 10.5).

The maximum content of even n-alkane homologues in the soil was observed during the leaf and root residual inflow and the process of its subsequent microbial degradation, which were detected by the shifting of homologs composition ratio. The content of ketones in the free OM fraction is low, because ketones formed during the oxidation of detritus of alkanes quickly undergo further biodegradation. At the same period, there was a relative increase of the content of n-methyl-ketones associated with the mineral part of the soil. This is possible during the mineralization of the corresponding n-alkanes, strongly bound in the layers in organo-mineral complexes of soil particles, but available to microorganism action. n-Alkanes become vulnerable to fermentative oxidation, which contributes to surface n-methyl-ketones enrichment [2] that slows down the process of n-methyl-ketones mineralization.

References

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