

Humic acids isolated from various types of podzols in Arctic ecosystems – ¹³C CP/MAS NMR spectroscopy

Nizamutdinov T.¹, Pechkin A.², Abakumov E.¹

¹Saint Petersburg state university, St. Petersburg, Russia, timur_nizam@mail.ru

²Arctic Research Center of the Yamal-Nenets Autonomous District, Salekhard, Russia

Keywords: nuclear magnetic resonance, soils, agrosols, YANAO

DOI:

The soil cover of Arctic ecosystems is highly differentiated in terms of soil types. Here one can see various typical background soils of the region, soils subjected to the effects of urbanization and even agrogenic and post-agrogenic soils. Our study focused on various podzols localized around the town of Nadym (Yamalo-Nenets Autonomous Okrug, Russia, 65.5333 72.5166). Four key objects of study were selected: 1 – typical (mature) podzol (Albic Podzol (Turbic)); 2 – urbanized podzol (Albic Podzol (Anthrotoxic)); 3 – agrogenic podzol (Plaggic Podzol (Turbic)); 4 – post-agrogenic podzol (Plaggic Podzol (Turbic)). Humic acids (HA) were isolated from the topsoil horizons AO, AOu, Ap, by the standard IHSS method.

Major differences in the chemical composition of HA were found, with urbanized podzols containing a greater proportion of aromatic compounds (110-160 p.p.m.), and agrogenic and natural more alkyl compounds (0-46 p.p.m.). Alkyls content decreases in the series pristine>agrogenic>post-agrogenic>urbanized (Figure 1).

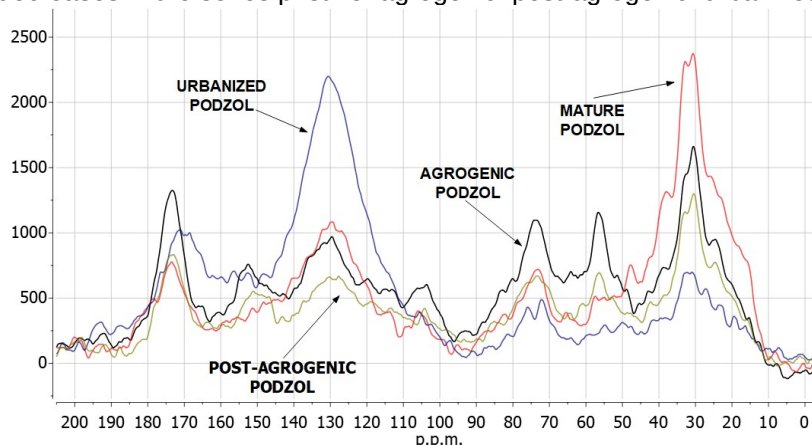


Figure 1. ¹³C NMR spectroscopy of the humic acid isolated from the topsoil horizons. X-axis – chemical shifts (p.p.m.); Y-axis – intensity of the signal.

Calculation of the quality indicators of humus indicates that in pristine soils humic acids are more stable, compared to agro- and urban ecosystems (Table 1).

Table 1. The content of the structural fragments in the humic acid

Soil	Chemical shifts from ¹³ C, %						AR	AL	AR/AL	Al h,r+ Ar h,r	C,H- Al/O,N
	0-46	46-60	60-110	110-160	160-180	180-200					
Mature	41,1	6,6	13,8	23,6	9,1	5,8	32,8	67,2	0,49	55	2,0
Agrogenic	34,2	9,0	14,9	20,6	14,0	7,3	34,6	65,4	0,53	49	1,4
Post-agro	34,8	7,7	14,5	23,1	13,2	6,7	36,3	63,7	0,57	49	1,6
Urbanized	18,5	3,7	9,7	46,0	14,5	7,6	60,6	39,4	1,54	28	1,4

AR (aromatic fraction) – the sum of the AR structural fragments; AL (aliphatic fraction) – the sum of the AL structural fragments; Al h,r + AR h,r – degree of hydrophobicity (%); C,H-AL/O,N-AL – degree of humification

Increased anthropogenic pressure on the ecosystem leads to a decrease in the degree of hydrophobicity and humification of humic acids.

Acknowledgements: this work was supported by Russian Foundation for Basic Research, project No 19-05-50107.