Mineralogical composition changes of postagrogenic soils under different plant communities.

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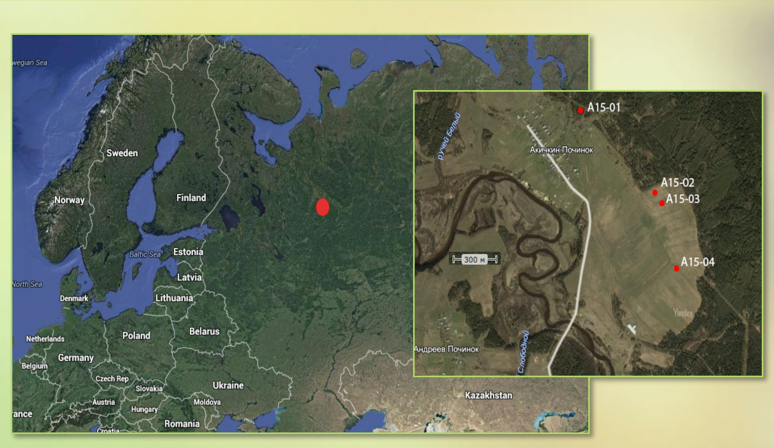
Introduction

Plant communities play the leading role in transformation of soil. The need of studying former arable lands increases due to large number of abandoned lands in Russia. It is necessary to study mineralogical composition of soils involved into natural processes to understand the trends of their development after agricultural activities in the past.

The aim of the study is to identify changes in mineralogical composition of soils under the influence of different plant communities.

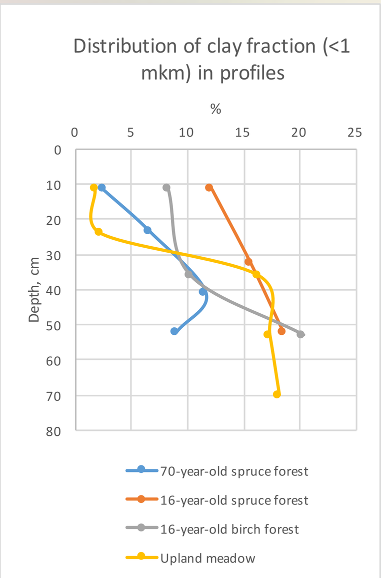


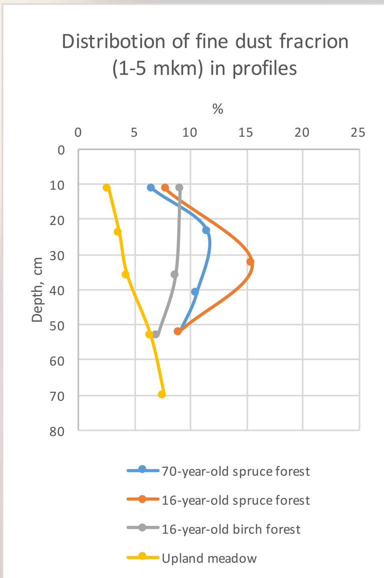
Soils were sampled in the south of Arkhangelsk region, Ustyansky district, near Akichkin Pochinok village.

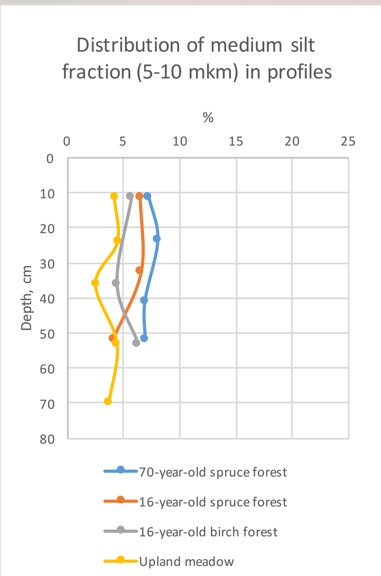
Methods

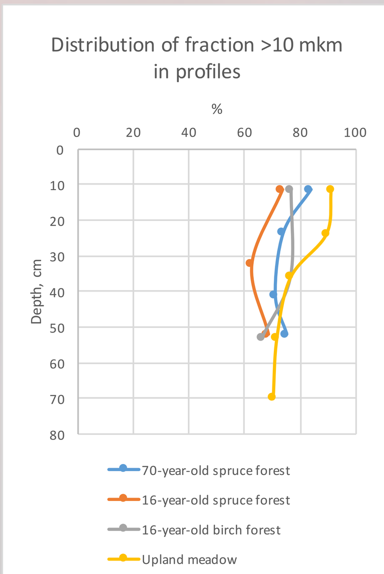
To separate soil fractions <1 micron, 1-5 micron and 5-10 micron samples were rubbed into a thick paste and sedimented. Oriented preparations of fractions were examined by XRD method. The content of the main mineral phases in the fraction less than 1µm is determined by the method of Biscaye

Granulometric composition of soils



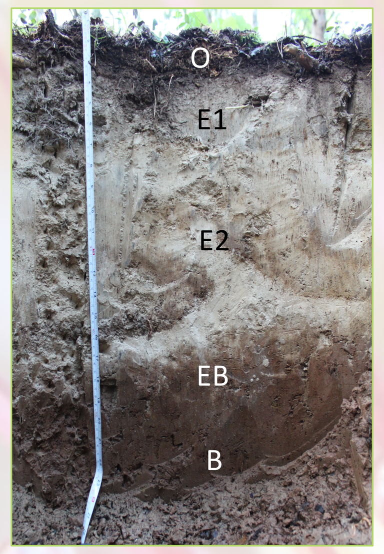






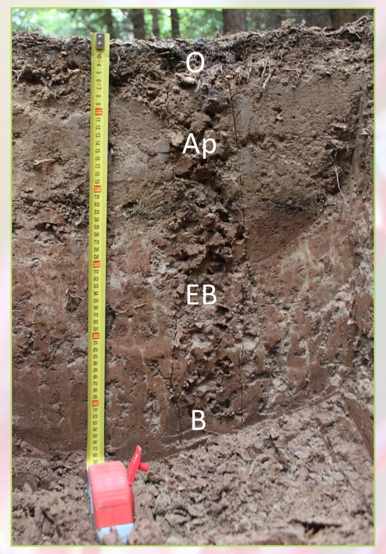
The following differentiation of finely dispersed fractions is a result of soil formation under different plant communities: the sharpest differentiation in the distribution of fractions <1 µm can be see under the old spruce forest and upland meadow.

Spruce forest (70 years old) A15-01



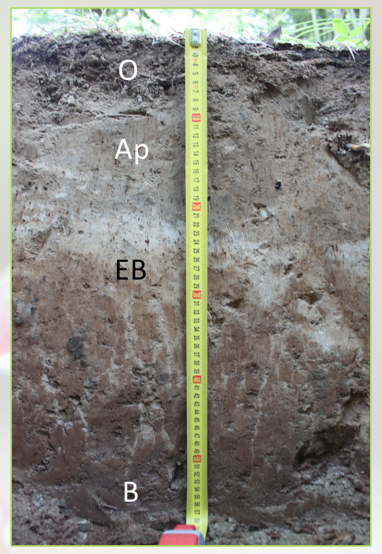
Albic Dystric Retisol (Cutanic Abrubptic Loamic)

Spruce forest (16 years old) A15-02



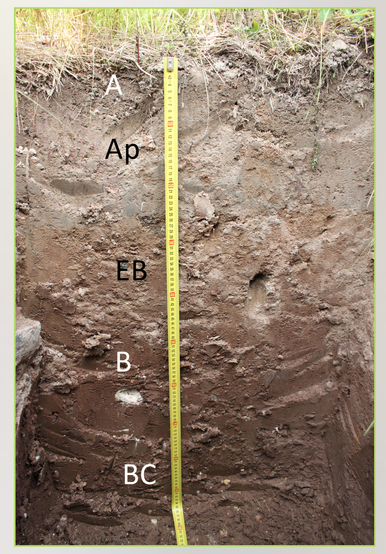
Dystric Retisol (Cutanic Loamic Anthraquic)

Birch forest (16 years old) A15-03



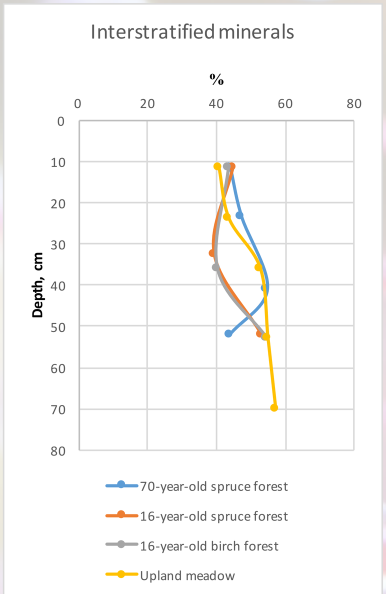
Glossic Albic Dystric Retisol (Cutanic Loamic Anthraquic)

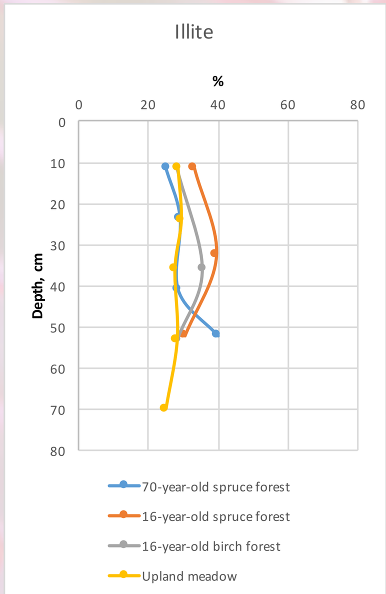
Upland meadow A15-04

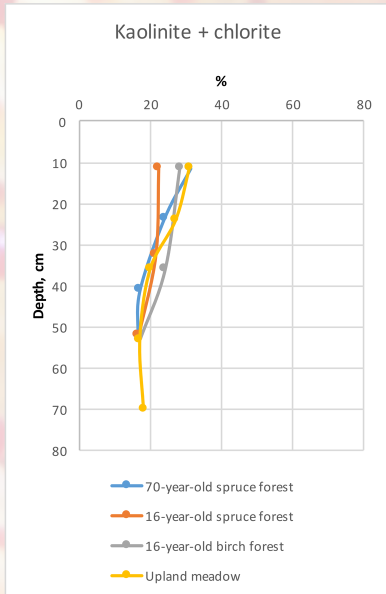


Dystric Retisol (Loamic Abruptic Anthraquic)

Fraction <1 µm





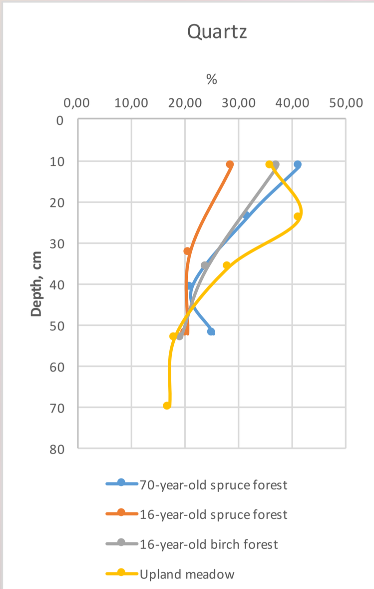


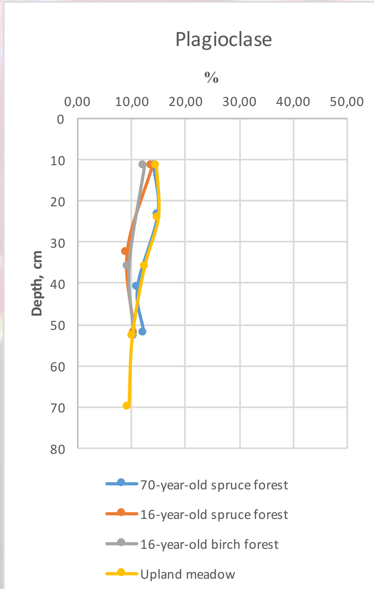
Mineralogical composition of the fraction <1 µm of the parent rock (moraine of the Moscow glaciation) is represented by iterstratified minerals with domination of mica-smectites. Chlorite-smectites, chlorite-vermiculites have a less content and these minerals account for 57%. Further descending followed illite (25%) and kaolinite+chlorite (18%). The processes of soil formation led to the following differentiation of the amount of clay fraction and minerals in it. The differentiation in mineralogical composition is due to the distribution of mica-smectite, which are destroyed and removed from the eluvial part of the profile. Illite tends to decrease in the profile. At the same time, kaolinite and chlorite accumulate in the eluvial part. The most clearly differentiation can be seen under the 70-year-old spruce forest.

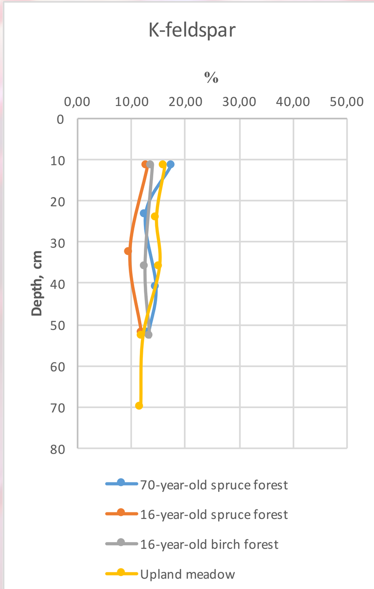
Chemical analyses

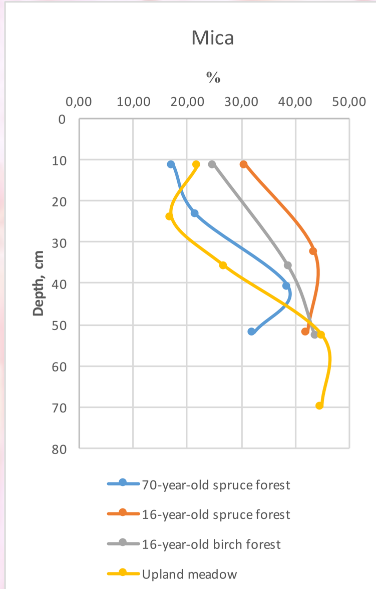
Soil	Horizon	pH	P_2O_5 mg/100g	Exchangeable cations (mEq/100 g)		CO2 %	K_2O mg/100g	Fe_2O_3, %		Humus %	Mn mg/kg
				Ca^{2+}	Mg^{2+}			Mehra-Jackson	Tamm		
Albic Dystric Retisol (Cutanic Abruptic Loamic)	ELp	4,68	6,26	0,69	0,27	-	8,02	0,71	0,71	2,10	66,00
	ELf	5,32	1,62	1,37	0,86	-	6,35	0,79	0,79	0,00	12,50
	BEL	5,69	1,05	10,79	4,37	-	15,14	1,85	1,85	0,00	0,00
	BT	6,38	3,16	14,44	4,91	-	14,03	1,48	1,48	0,00	783,25
Dystric Retisol (Cutanic Loamic Anthraquic)	Pe	5	4,85	2,38	0,95	-	6,74	1,08	1,08	0,99	352,75
	BEL	5,66	4,43	6,26	2,00	-	12,31	1,29	1,29	0,00	621,00
	BT	6,1	9,21	5,78	4,03	-	14,11	1,37	1,37	0,36	720,50
Glossic Albic Dystric Retisol (Cutanic Loamic Anthraquic)	P	4,84	2,18	1,62	0,56	-	5,71	0,66	0,66	1,56	783,75
	BEL	5,5	2,18	1,09	0,52	-	6,52	1,07	1,07	0,00	186,50
	BT	6,04	5,98	11,52	4,42	-	14,96	1,06	1,06	0,00	840,50
Dystric Retisol (Loamic Abruptic Anthraquic)	Ad	5,44	4,57	5,23	1,03	-	5,71	0,76	0,76	1,77	931,00
	P	5,8	3,73	2,80	0,55	-	6,52	0,61	0,61	1,25	310,00
	BEL	6,05	4,85	5,17	1,92	-	14,96	0,96	0,96	0,00	0,00
	BT	7,15	12,87	20,55	4,94	0,09	15,67	1,07	1,07	0,00	887,50
	BC	7,86	25,73	> 28,17	>20,18	0,97	13,46	1,29	1,29	0,00	1154,75

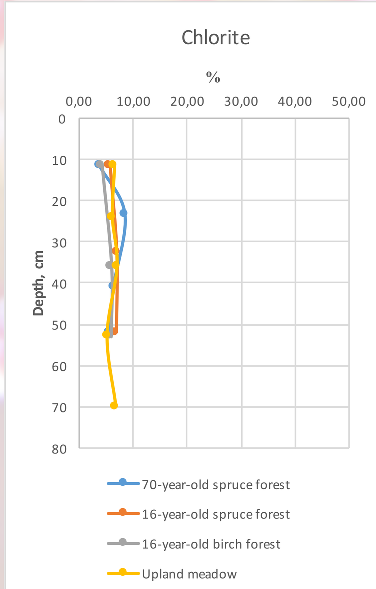
Fraction 1-5 µm

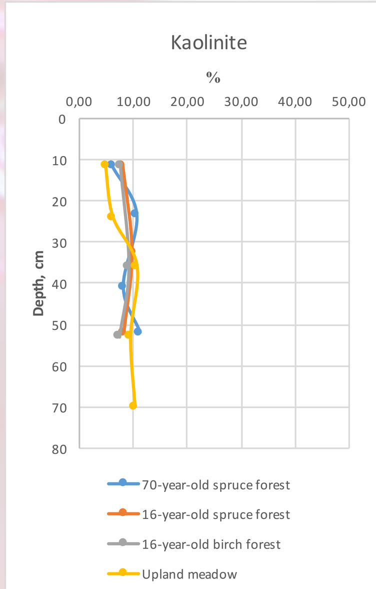






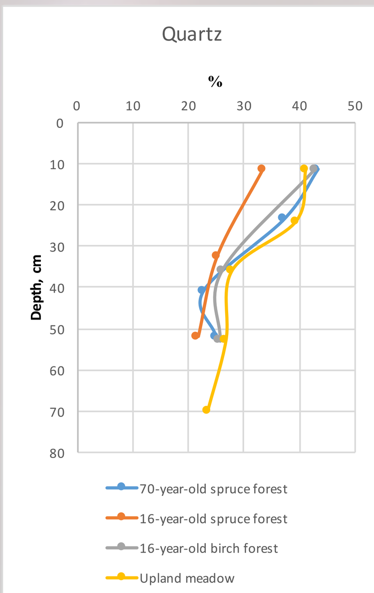


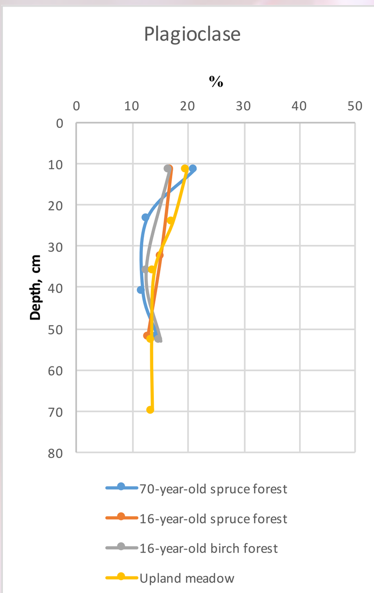


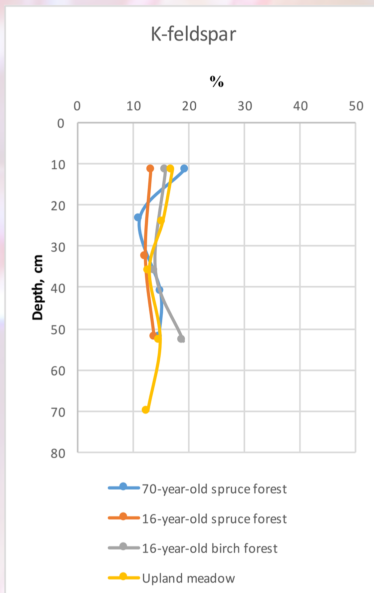


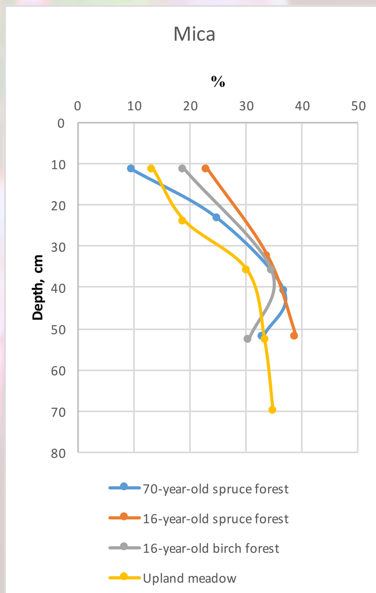
This fraction consists of the following clastogenic minerals: quartz (17-41%), potassium feldspars (10-17%), plagioclases (9-15%) and layered silicates: mica (17-45%), kaolinite (5-11%), chlorite (3-8%). Under the influence of soil formation, we can see the accumulation of the quartz in the upper part of profile. In this case, the distribution of quartz under the upland meadow is the most differentiated. Distribution of plagioclases is less differentiated. Potassium feldspars mostly accumulate at the top of the profile under the old spruce forest. Among layered silicates we can also notice differentiation in the profile. The most differentiation of mica is noticed under the old spruce forest; in the upper horizons chlorite is destroyed. The process of soil formation leads to accumulation of quartz and potassium feldspars in the eluvial part of the profile. Mica and chlorite are destroyed.

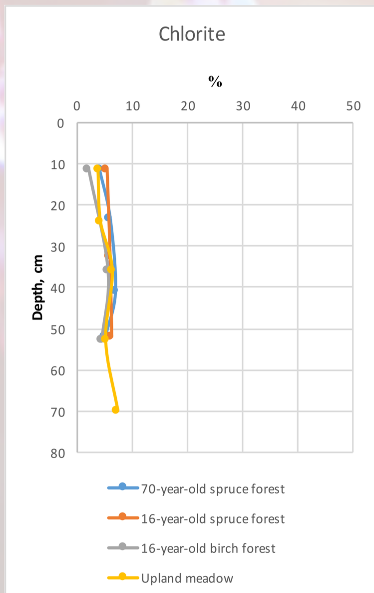
Fraction 5-10 µm

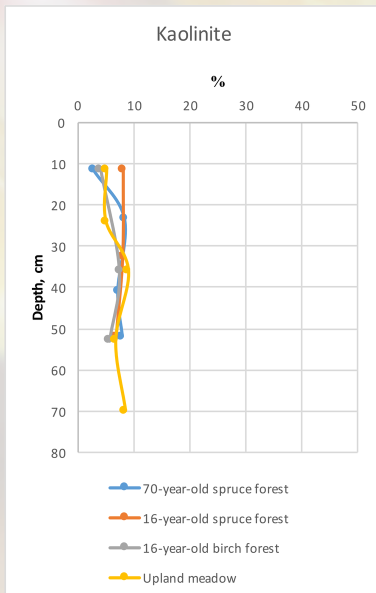




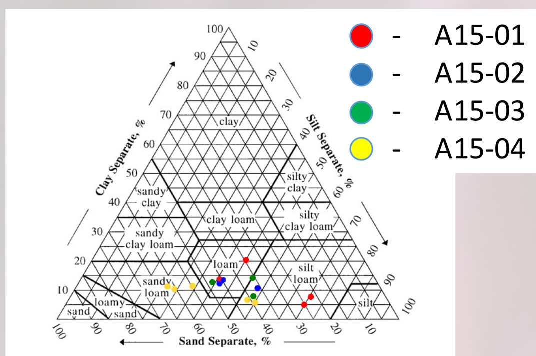








The fraction 5-10 µm consists of the following clastogenic minerals: quartz (22-43%), plagioclases (11-21%), potassium feldspars (11-19%) and layered silicates: mica (9-36%), kaolinite (2-9% %), chlorite (2-7%). Content of quartz is much higher comparing to 1-5 µm fraction. In connection with a bigger size of the crystals, the destruction of minerals is less significant under the influence of soil formation. There is accumulation of grains of quartz and destruction of mica. It can be noted that the accumulation of potassium feldspars in the eluvial part of the profile is not vey high.



General characteristic of all profiles is the dominance of fine sand fraction (> 50 microns). There is a bright difference between the top and bottom parts of all soil profiles registered by prevalence of fine silt fraction (1-5 microns) in the upper horizons.

Conclusion.

1. Soils are characterized by acidic reaction medium in the upper horizons, rolling in neutral down the profile. In the upper horizons the content of organic matter ranges from 1 to 2%. CEC significantly varies within the profiles and correlates with content of silt. Exchangeable calcium is dominant.
2. Distribution pattern of all fractions is eluvio-illuvial. The upper layers contain minimal amount of clay fraction. Profile differentiation depends on type of vegetation. Highest differentiation is observed under upland meadow and under the spruce.
3. Upper horizons have less content of interstratified minerals, what is a main sign of profile differentiation. These horizons have the accumulation of chlorite-vermiculite, kaolinite and quartz. In the silty fraction of eluvial profile part the amount of finely-dispersed quarz increases

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