GRANULOMETRIC COMPOSITION AND MAGNETIC SUSCEPTIBILITY OF THE LATE PLEISTOCENE LOESS-SOIL SEQUENCE OF THE STRATOTYPE SECTION (ALEXANDROVSKY QUARRY, KURSK, RUSSIA)

Zakharov A., Sycheva S., Panin P.

Institute of Geography, Russian Academy of Sciences, Moscow, Russian Federation

alzakharov@igras.ru

INSTITUTE OF GEOGRAPHY
Russian academy of sciences
founded in 1918

Protected natural monument “Mikulinsky paleobalka and the Late Pleistocene paleosol-sediment series in the Alexandrovsky quarry”

Alexandrov quarry

Russian Plain, Central Russian Upland Northern part of the “Chernozem belt”

Continental climate

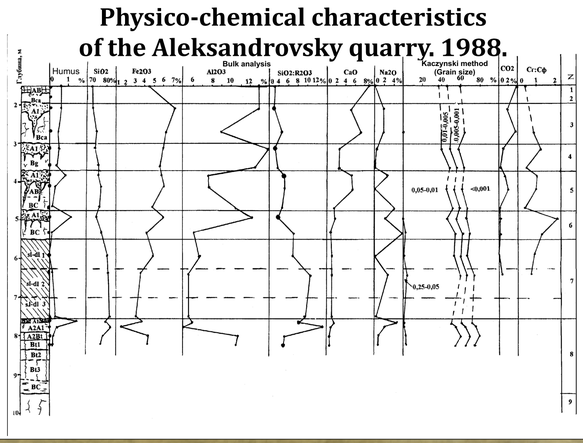
MAT 5.2°C
MT January -8.3°C
MT July 18.9°C
MAP 580 mm

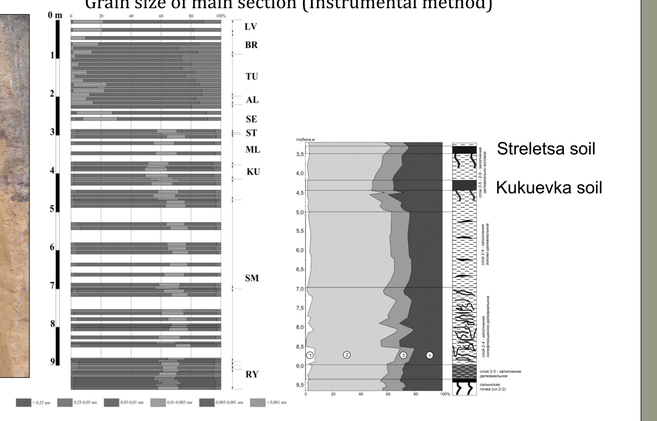
Granulometric composition and magnetic susceptibility are important indicators of the genesis of paleosols, loesses and other newest sediments. Along with other characteristics, they make it possible to reconstruct evolution, surrounding landscapes and climatic changes in the past. The stratotypic section "Alexandrovsky quarry" (natural monument in Kursk, 51°35′31″N, 36°3′21″E) reveals the most complete structure of the Late Pleistocene for the periglacial zone of the East European Plain. Soil-sediment stratum with a thickness of more than 10 m represents the filling of a small buried valley. The formation of the stratum took place practically without interruptions during the last 130 thousand years. It includes two interglacial paleosols: Holocene (Marine Isotope Stage 1) and Ryshkovo (MIS 5e); four interstadial paleosols: Kukuevka (MIS 5c), Streletsa (MIS 5a), Alexandrovka (MIS 3.1), Bryansk (MIS 3.2), and also loess, pedo-sediment and other deposits that have periodically experienced exposuring to cryogenesis [Sycheva, 2012]. The particle size distribution and the magnitude of the magnetic susceptibility reflect the complex history of the stratum formation and reveal detailed climate changes in the Late Pleistocene. The particle size distribution was determined with fractionation method by Kaczynski and by instrumental laser-diffractometry method on a "Malvern Mastersizer 3000" particle size analyzer. The magnetic susceptibility was determined by a SatisGeo KM-7m field capameter with triplicate measurements for every 6 cm.

A change in the granulometric composition from Ryshkovo (MIS 5e) medium loamy deposits to heavy loamy soils and loess belonging to MIS 3.1 was established. The largest value of the clay fraction (<0.001 mm) is characteristic of the MIS 3 paleosols. Significant values of this fraction are also characteristic of the humus horizons of paleosols and Bt horizon Rushkovo paleosol (MIS 5e). The lowest clay content is observed in loess, especially in their upper parts and in the eluvial horizon of the Rushkovo paleosol (MIS 5e). The data gained by instrumental method of particle size determination is different from such as data gained by the Kaczynski method for the upper heavy loam stratum (MIS 3-1). The predominant fraction is fine dust, in contrast to the lower sediments MIS 5-4, where the coarse silt fraction prevails. Whereas according to data gained by Kaczynski method, the coarse silt fraction prevails in the entire studied thickness of the loess-soil sequence.

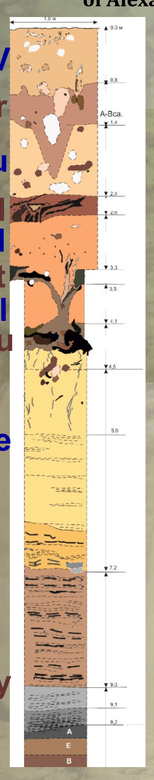
Magnetic susceptibility (MS) depends on the content of superparamagnetic mineral in each of the samples and represents levels of pedogenesis in loess deposits. The highest MS values are characteristic of the humus horizon of the interglacial Rushkovo paleosol (MIS 5e). Followed by Ah horizon of the Streletsa paleosol (MIS 5a) and underlying loess. Smaller values are characteristic of the Kukuevka (MIS 5c) paleosol. But they are more eroded and represented by transitional AB horizons. Loess is characterized by the lowest values of magnetic susceptibility.

Physico-chemical characteristics of the Aleksandrovsky quarry. 1988.



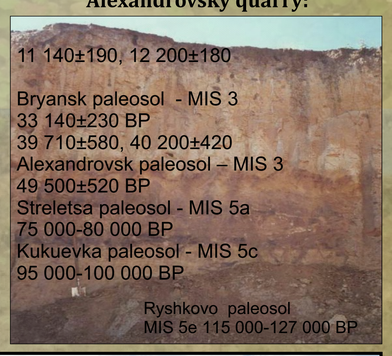


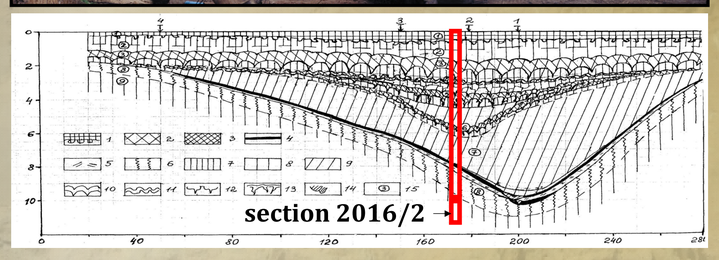
Late pleistocene stratigraphy of Alexandrovsky quarry



LV – MIS 2 loess
Br – Bryansk paleosol (MIS 3)
Tu – Tuskar loess (MIS 3)
Al – Alexandrovsk paleosol (MIS 3)
Sl – Selihovodvor loess (MIS 4)
St – Streletsa paleosol (MIS 5a)
Ml – Mlodat loess (MIS 5b)
Ku – Kukuevka paleosol (MIS 5c)
Se – Seym horizons (MIS 5d)
Ry – Ryshkovo paleosol (MIS 5e)

Geochronology of Alexandrovsky quarry:





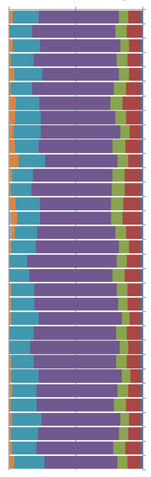
Correlation of stratigraphic schemes for Late Pleistocene glacial and loess regions of the East-European plain and Marine isotope stages (MIS).

Unit	Glaciations, interglacials, stages (or coolings), interstadials		Loess layers, fossil soils (FS) and cryogenic horizons of the East European periglacial zone		MIS
	According to Arslanov (1987) for glacial regions		According to Velichko et al.(1997)	According to Sycheva (1998),Sycheva et al.(2007)	
Holocene	Holocene		Holocene soil	7 Holocene soils	1
Upper Pleistocene	Late Valdai	Late Dryas	Altynovo loess III, 'Yaroslavl' cryogenic horizon	Loess	2
		Allerod		3 4 inter-phase soils	
		Older Dryas			
		Bolling			
		Oldest Dryas			
		Rasnitsa interstadial	Trubchevsk interstadial soil		
		Vepsov stage			
		Warming			
		Bologovo-Edrov, maximum stage	Desna loess II Vladimir cryogenic horizon	Loess, wedge-shaped structures	
	Middle Valdai	Bryansk (Dunai) interstadial	Bryansk interstadial soil	Bryansk soil	3
				Loess, cryoturbation	
				Monastyrsk soil	
		Levastziemsk (Mikhalinov) cooling		Loess	
		Interstadial Grajdanskiy avenue		Hydrouzel soil	
		Shapkinsk cooling		Tuskar loess + solifluctions, cryoturbations	
		Krasnogorsk (rokan) interstadial		Alexandrov soil	
	Early Valdai	Shestikhinsk cooling	Khotylevo loess I. Smolensk cryogenic horizon	Selihovodvor horizon loess, solifluctions, cryogenic structures	4
		Kruglitzk interstadial (Ionensa 2)	Krutitsa interstadial soil	Streletsa soil	5a
		Cooling		Mlodat loess, solifluction, colluvium	5b
		Tosna interstadial (Ionensis 1, upper Volga)		Kukuevka soil	5c
		Kruglovsk cooling	Sevsk loess	Seym horizons: solifluctions, colluvium, alluvium	5d
	Mikulino (Eemian) interglacial		Salyn interstadial soil	Ryshkovo (Mikulino) soil complex: 3-4 pedogenic + 3 morpho-lithogenic phases	5e

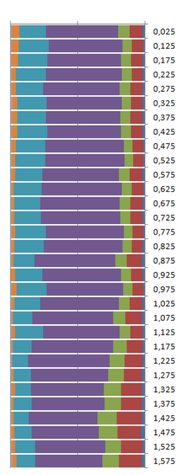
New data on grain size characteristics of main section and nearby section with paleodell

- 0.0001-0.001
- 0.001-0.005
- 0.005-0.01
- 0.01-0.05
- 0.05-0.1
- 0.1-0.25
- 0.25-0.5
- 0.5-1.0
- 1.0-2.0
- >2.0

section 2016/2
ottom of paleo gulch



section 2016/4
Paleodell



1 - humus horizon
2 - Illuvial horizon
3 - redeposited soil
4 - loess layer
5 - lime horizon
6 - cryogenic structures
7 - glei horizon
8 - eluvial horizon
9 - signs of stratification
10 - crotovina
11 - layer ID

LAYERS

1 — Holocene chernozem (MIS 1)
2 — Late Valdai loess (MIS 2)
3 — Bryansk soil (MIS 3)
3a — Tuskar loess (MIS 3)
4 — Alexandrovsk soil (MIS 3)
4a — Selihodvor loess (MIS 4)
5 — Streletsa soil (MIS 5a)
5a — Mlodat loess (MIS 5b)
6 — Kukuevka soil (MIS 5c)
7 — Seym loess (MIS 5d)
8 — Ryshkovo soil (MIS 5e)
9 — Moscow loess (MIS 6)

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