IUSS Commission 1.6

PALEOPEDOLOGY

Institute of Geography, Russian Academy of Sciences
Ecological Soil Science Institute, Moscow State University
V.V. Dokuchaev Soil Science Institute
Institute of History of Material Culture, Russian Academy of Sciences
Kursk State University
Lipetsk State Pedagogical University
Government of Kursk region, Ecological Department
V.V. Alekhin Central-Chernozemic State Biospheric Reserve
Natural Architectural-Archaeological Museum-Resort “Divnogor’e”

"PALEOSOLS, PEDOSEDIMENTS AND LANDSCAPE MORPHOLOGY AS ENVIRONMENTAL ARCHIVES"

MATERIALS OF THE XIITH INTERNATIONAL SYMPOSIUM AND FIELD WORKSHOP ON PALEOPEDOLOGY (ISFWP) KURSK, RUSSIA AUGUST 10−15, 2013

Moscow, Kursk
2013

Materials of the XIIth International Symposium and Field Workshop on Paleopedology (ISFWP) “Paleosols, pedosediments and landscape morphology as environmental archives” are presented in form of abstracts in this issue. XIIth ISFWP is the traditional activity of IUSS Commission on Paleopedology. The event is devoted to the discussion of soil, geomorphic, sedimentary records of Pleistocene and Holocene climatic changes based on the synthesis of soil scientists, geomorphologists, sedimentologists, archeologists knowledge.

EDITORS:

M.A. Bronnikova, S.A. Sycheva, A.O. Makeev

REVIEWERS:

Dr. D.I. Luri
Dr. D.E. Konyushkov

Issue with financial support of RFBR

ISBN 978-5-89658-047-8

LOESS- AND TEPHRA-PALEOSOL SEQUENCES

STRATIGRAPHY AND INTERRIGIONAL CORRELATION OF THE PLEISTOCENE LOESS-PALEOSOL SEQUENCES OF THE CENTRAL AND EASTERN RUSSIAN PLAIN

Glushankova N.

Department of Geography, Moscow State University, Moscow, 119899 Russia, ni.glushankova@mail.ru

The results of the chronostratigraphic subdivision of the loess-paleosol formation (LPF) of the East European Plain are presented. A correlation of basic paleogeographical events of the loess areas in the Pleistocene has been carried out. It is shown that the period of the IPF development on the East European Plain comprises 17 paleogeographic stages (9 interglacials and 8 glacials between them) – Petropavlovka interglacial (Interglacial 1, Waardenburg), Pokrovka cooling (Glacial A), Early Illinka interglacial (Interglacial 2, Westerhoven), Inter Illinka cooling (Glacial B, Unstratian), Late Illinka interglacial (Interglacial III, Rosmalen), Don glacial (glacial C), Muchkap interglacial (Belovezh, Interglacial IV, Noordbergum), Oka glacial (Elsterian), Likhvin s.str. interglacial (Holsteinian), Borisoglebsk glacial, Kamenka interglacial (Domnitz), Orchik cooling, Romny interglacial, Dnieper glacial (Saalian), Mikulino interglacial (Eemian), Valdai glacial (Weichselian) and the continuing Holocene interglacial. Environment and vegetation evolution of the epochs of the loess and soil formation in the East-European loess province has been characterized by paleosoil data of the reference sections of the East European Plain: the Upper Don, Middle Volga, Upper Kama regions. Complex studies of morphogenetic and geochemical properties of buried soils show expressive individual features of paleosols of different geochronological stages of Pleistocene related to different types of ancient pedogenesis. They also show a similarity of typological features of soil formed during the same time intervals, and their regional differences connected with both geographical situation and geological-geomorphological conditions.

The research was supported by the Russian Foundation for Basic Research (project 12-05-00372).

PEDOGENIC CARBONATE COATINGS AS A RECORD OF ENVIRONMENTAL CHANGES AT SOUTH PRIBAYKALIE

Golubtcov V.A.[1], Cherkashina A.A.[1]

[1]V.B. Sochava Institute of Geography SB RAS, Russia, tea_88@inbox.ru

Pedogenic carbonate coatings occurring beneath coarse clasts were investigated in a Late Quaternary (Upper Pleistocene to Holocene) loess-like palaeosol sequence located in the southern part of the Irkutsk region (Russia) on the Irkutsko-Cheremkhovsaya plain on the left bank of Belaya river - left tributary of Angara river (N 52°52.500′, E 103°28.206′). Carbonate coatings are widely distributed in the middle part of describing section. They show a succession of two or three types of laminae with strongly differentiated overall characteristics. Each lamina consists of weakly differentiated micro-laminae. Three groups of coatings were distinguished based on character of combinations of layers, from which underlying coatings are most homogenous and upper coatings are characterized by quite abrupt borders between inner and outer layers. Inner and outer laminae of coatings were analyzed for stable C and O isotopic composition, morphological features on different levels of structure organization, mineralogical and elemental composition. All isotopic results are given in relation to PDB.

XRD showed that main mineral constituents of coatings are calcite with *d*-spacing 3.02 Å and small amounts of crystalline silicates. The SEM analysis revealed that inner layers of upper coatings and underlying neoformations consist of cryptocrystalline calcite with monolithic structure. Microprobe analysis showed Fe and Al peaks which probably inferred from films of sesquioxides on calcite crystals surfaces. The brown color of describing layers supports this assumption. Outer layers of upper coatings consist of silicate matrix with loosely packed radial fibrous calcite spherulites. Microprobe analysis indicated Ca and Mg peaks inferred from carbonates and Si peaks inferred from matrix. In both cases fast growing of calcite from supersaturated solutions is assumed. Quite positive values of $\delta^{13}C$ (in average – 4 ‰) for all coatings give us evidence to conclude that precipitation of pedogenic carbonates relates to supersaturation of solutes which is induced when soil water is freezing. For our assumption, there are three main factors, determining differences in morphology of calcite in inner and outer layers of coatings: 1) differences in interactions between soil fabric and the precipitating carbonates; 2) differences in degree of solutions saturation in respect to carbonates; 3) sesquioxides, clays and organic matter in soil solutions which can deposit on crystal faces and limit the rate of diffusion to crystal surface which favors nucleation of new crystal than ionic augmentation of existing ones. It can cause forming of cryptocrystalline monolithic structure.

The $\delta^{13}C$ values of organic matter of modern soil and paleosols in section vary from −24.11 ‰ to −22.52 ‰. $\delta^{13}C$ values of pedogenic carbonate coatings are in average – 4 ‰ in inner laminae and – 5.3 ‰ in outer one. Based on this data, we suppose that coatings were formed under conditions of C3 ecosystems without admixtures of C4 plants. Simultaneously, they formed under strong influence of atmospheric CO_2. This suggests that freezing of soil solutions was an important mechanism for carbonate coatings formation. In general, a trend towards more negative $\delta^{13}C$ values from the inner to outer layers is evidence for shift to warmer climatic conditions. There is a general increase in $\delta^{18}O$ values from the oldest to the youngest laminae (in average, from – 14 ‰ to – 11 ‰). Two major factors are supposed to influence an increase in $\delta^{18}O$ values of meteoric water and carbonates, respectively: an increase of air temperatures and/or decrease in precipitation. It seems reasonable to suppose that $\delta^{18}O$ values in this case were controlled primarily by air temperatures.

The data obtained from pedogenic carbonate coatings are important for paleoenvironmental reconstructions. They provide possibility to trace directions of local environmental changes on examined territory.

STRATIGRAPHY AND PEDOGENESIS OF THE SANGAMON GEOSOL IN THE MIDCONTINENT OF NORTH AMERICA.

Peter M. Jacobs[1], Michael E. Konen[2], B. Brandon Curry[3], Joseph A. Mason[4]

[1]Department of Geography, University of Wisconsin-Whitewater, Whitewater, Wisconsin
[2]Department of Geography, Northern Illinois University, Dekalb, Illinois
[3]Illinois State Geological Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, Champaign, Illinois
[4]Department of Geography, University of Wisconsin-Madison, Madison, Wisconsin

The Sangamon Geosol provides a terrestrial record of pedogenesis during the last interglacial to glacial transition across a broad area of central North America. The occurrence of the Sangamon Geosol as a distinct stratigraphic unit extends across areas of North America that accumulated late Pleistocene sediments, and it is an especially widespread and important stratigraphic marker in regions where late Pleistocene loess accumulated. The chronology of the Sangamon Geosol is variable. In most instances the Geosol formed throughout marine isotope stage (MIS) 5 and 4, and in instances of very slow loess sedimentation, soil formation continued through MIS 3. The duration of soil formation ranges from ~70 to 100 ka.

Profile characteristics are almost uniformly texture-contrast profiles, with eluvial upper sola and illuvial lower sola. In many instances the texture contrast is enhanced because the upper sola developed in a thin loess deposit that slowly accumulated on the land surface during MIS 3. Where the MIS 3 loess unit is thick, the Sangamon Geosol is isolated. Across much of the area, the Geosol continued to develop, resulting in an "over-thickened" upper solum with characteristics that reflect cooling climate and changing environmental conditions. The upper solum is recognized as the Farmdale Geosol and it commonly occurs as a pedocomplex named the Farmdale-Sangamon Geosol.

Texture-contrast is lost in poorly drained profiles, and one profile type (facies) of the Geosol is called *accretion gley*, named because it formed from the slow alluvial accumulation of silt and clay in a wetland. Except accretion gley profiles, evidence of clay illuviation is pervasive in the B horizons all across the region of occurrence. Most profiles formed initially via top-down pedogenesis in a variety of landscape settings, and paleodrainage conditions are often readily identifiable. In low relief regions, the Sangamon Geosol forms a continuous soil cover that was buried beneath MIS 2 loess, and characteristics of the paleosoilscape can be reasonably deciphered from the topography and soil geomorphology of the modern soilscape. In higher-relief landscapes, the Geosol is preserved only beneath uplands, because MIS 2 hillslope erosion removed the stratigraphic unit from hillslopes and valley bottoms.

The Sangamon Geosol shows extensive evidence of mineral weathering, including depletion of weatherable silt and sand minerals, along with extensive alteration of clay minerals. In well drained upland profiles, mica and chlorite are depleted and interlayers of expandable clay minerals are filled with hydroxy interlayers or become randomly interstratified with kaolinite. The thickness of soil profiles is a function of parent material particle size characteristics; profiles formed in sandy outwash are much thicker and more weathered than profiles formed in clayey sediments.

Historically, most profiles have been interpreted as forest soil profiles, but the upper sola formed in loess often is a thick and dark A horizon interpreted as forming under grassland, especially in the western areas that today receive less rainfall. Lacustrine records of pollen and ostracodes from the type area indicateat least two wet-dry cycles with corresponding vegetation shifts between forest and grassland.

THE CARBON ISOTOPIC COMPOSITION OF ORGANIC MATTER AND THE AGE OF PALEOSOLS FROM WURM GLACIATION INTERSTADIALS TO HOLOCENE (EXAMPLE OF PALEOSOLS AND PEDOSEDIMENTS FROM BRYANSK REGION, RUSSIA)

Kovaleva N.O.[1], Stolpnikova E.M.[2], Kovalev I.V.[3]

[1]Institute of Ecological Soil Science MSU, Russia, natalia_kovaleva@mail.ru
[2]A.N. Severtsov Institute of Ecology and Evolution, Russia, opallada@yandex.ru
[3]Soil Science Faculty of MSU, Russia

Paleosols of Trubchevsk district of the Bryansk region lie in landscape with its own characteristic microrelief, called Trubchevsk Opolie are well studied by paleopedologists and paleogeographers. However, studies of the isotopic composition of the carbon were not carried out earlier.

The objects of our study were: catena of geochemically conjugated landscapes by Trubchevsk Opolie, with the modern Grey Forest Soils and buried soils (second humus horizons); buried anthropogenic Holocene soils from Kvetun and Zhereno sites; Late Glacial sandy and loess-soil series submitted in sand pits. The oldest sandy pedosediments, opened in quarries, were formed in the Late Glacial period (Wurm glaciation end) and, have the cryogenic effects of freezing and thawing processes: layered texture, layers of iron accumulation, cold grayish colors, iron-manganese nodules.

According to the carbon isotopic composition of organic matter there was vegetation with C-3 type of photosynthesis in periods of surface stabilizing. The ratio δ^{13}Corg for sandy pedosediments varies in range −26.5–27.2 ‰ characterizes relatively humid climate. The buried soils lied above them formed during interstadials and dated 16 500 ± 230 Ki-17 414, 12 930 ± 170 Ki-17 413 years BP. These soils contain carbonates and have low humus content (0.5–0.7%). The younger soil contains a large amount of organic and inorganic form of phosphorus, calcium carbonate (6.4%), relatively high magnetic susceptibility and slightly weighted value δ^{13}Corg = −24.9 ‰ compared with the underlying and overlying sediments. Soil with age 16 500 BP formed in more humid conditions and has δ^{13}Corg = −25.6–26.5 ‰. From above it is covered with loess-like loam with δ^{13}Corg ratio equal to −23.1 ‰ characterized more arid conditions and the growth of C-4 plants proportion to 28%. The Holocene buried horizons formed on this loess. Buried soil (called the second humus horizon of modern soils) in microdepressions dated to 2180 ± 60 Ki-17 415 and is characterized by a high content of phosphorus, including its strong accumulation of organic compounds (635.8 mg/kg P_2O_{5org}), while the amount of organic forms of phosphorus present in the upper humus horizon is 178.7 mg/kg P_2O_5. The isotopic composition of organic carbon is distinguished by the light values: δ^{13}C = −28.4–29.5‰. We have also studied the isotopic composition of buried soils and cultural layers, dated by archaeologists to Neolithic, in other words, to the earlier and middle periods of the Holocene (5–7 kyr. BP). It characterizes the climate of these time as a humid (δ^{13}C = −26.6–27.4 ‰).

For the buried soil of the Middle Ages climatic optimum obtained similar values δ^{13}C = −26.3–26.5 ‰.

Thus, the studied paleosols and pedosediments reflect the history and landscape development in range from more than 16 500 years BP to modern time and being a witness of global climate change on the Pleistocene and Holocene boundary.

MAGNETIC MEMORY OF THE SOIL OF THE PALEOLITHIC LOESS AS AN INDICATOR OF CLIMATE DYNAMICS THROUGH PLEISTOCENE-HOLOCENE IN CENTRAL ASIA

Lomov S.P.[1], Zhou L.P.[2]

[1]Penza State University of Architecture and Construction, Russia
[2]Institute Quaternary researches Cambridge University, Great Britain

Stone artifacts are common for loess-paleosol formation in Central Asia. They are confined to paleosol horizons thus allowing V.A. Ranov to formulate innovative approach in archaeology – Paleolithic loess research. Paleoecology and migration routes of ancient people in the Subtropics of Central Asia are also of great importance for paleoclimatic reconstructions. High resolution magnetic susceptibility (MS) record was studied in Darai Kalon loess-paleosol section (Southern Tajikistan) starting from surface Holocene soil. MS was determined by the Bartington magnetic susceptibility meter m.s. 2 device and estimated in "χ" 10–8 m^3/kg of the soil. MS record was correlated to the deep-sea oxygen isotope curve.

Surface soils were studied between 500 and 2000 m a.s.l. under various landscape and climatic conditions (300–1200 mm MAP and 14–8.5° MAT). MS varies between 30–185. Among surface soils Serozems (in the Russian soil classification, Haplic Calcisol in WRB) formed in arid landscapes with low MS (30–60). Cinnamon soils (in the Russian soil classification, Kastanozems in WRB) are characterized by broader range of MS values (between 50–185).

The first pedocomplex in Darai Kalon section corresponds to MIS5 and is characterized by three peaks in MS – 108, 130, 120. The second pedocomplex corresponds to MIS7, exhibits well expressed horizonation with three peaks in MS, similar to the first one (112, 118, 135).

The third pedocomplex corresponding to MIS9 is characterized by the highest MS values (145, 215, 175), that matches with its morphological features: reddish color of middle and bottom part of the profile is typical for subtropical Mediterranean soils due to ferrugination (Lomov, 2008). All paleosols were formed in autonomic positions and correspond to leached Cinnamon soils, sometimes with ferrugination.

Paleosols of lower Neo-Pleistocene levels have low MS values (50–65, sometimes 88–105) and correspond to meadow Cinnamon semi-hydromorphic varieties. Lower parts of these pedocomplexes are characterized by carbonate crust described earlier (Lomov, 2009). Low permeability of such crust resulted in seasonal waterlogging that is responsible for low MS values. Loess horizons separating pedocomplexes have even lower MS values (18–30).

Surface soils show clear correlation between MAT and MAP and MS values allowing to differentiate between arid areas with Serozems (11.5–14.5 °C MAT, 300–750 mm MAP) and humid areas with leached Cinnamon soils (8.5–11.0 °C MAT and 900–1200 mm MAP). Such correlation could be used for paleoclimatic reconstruction for buried soil and loess horizons.

References

1. Lomov S.P. Environmental parameters of loess Paleolithic in Central Asia. Proceedings of the Russian Conference on Quaternary Research, Novosibirsk, 2009, p. 369–372. (in Russian)
2. Lomov S.P. Soils in the Subtropical Zone. Penza, 2008, 365 p. (in Russian)

LANDSCAPE AND ENVIRONMENTAL RECONSTRUCTION BASED ON LOESS-PALEOSOL SEQUENCES FROM SAXONY (GERMANY)

Sascha Meszner[1], Sebastian Kreutzer[2], Markus Fuchs[2], Dominik Faust[1]

[1]Institut of Geography, Dresden University of Technology
[2]Department of Geography, Justus-Liebig-Universität Gießen

The Saxonian loess area is located at the northern branch of the European loess belt close to Elbe river and between the cities of Dresden and Riesa. This region representing the transition zone between the Erzgebirge upland in the south and the Northern European Plain in central East Germany and is characterized by a 5–20 m thick cover of mainly Weichselian loess. On the base of eight well investigated loess-paleosol sequences a regional loess standard profile of the Weichselian glaciation could establish advancing existing composite profiles according to Lieberoth (1963) and Haase et al. (1970).

More than 30 OSL age estimations taken from several sites build up the chronological frame of this stratigraphical stack.

Due to this high resolution chronostratigraphy a reconstruction of paleotemperature, soil moisture regimes, wind speed, redepostition, and landscape evolution dynamic phases could present. This reconstruction mainly based on geomorphological, pedological, and sedimentological features of individual loess-paleosol sequences. Special value we set on layer boundaries or shifts in the grain size distribution for detecting unconformities and hiatuses. To distinguish between paleosols and soil sediments a combined interpretation of results from pedochemical analyses and field observations were applied.

One finding of this study is the detection of a loess sedimentation period between 62 and 72 ka which occurred after the formation and redeposition of the early Weichselian humus enriched soils. Additionally, in this period of sedimentation an in situ brown interstadial soil is preserved and link to a warm and dry interstadial with an age estimation of approximately 68–70 ka.

Expecting interglacial soils, most other paleosols show clear evidences for redeposition in this loess area.

A similarity of all profiles is an unconformity before upper Weichselian loess sedimentation restarts. This hiatus spans a period of approximately 25 ka (from 65–30 ka) and is located in the Gleina interstadial soil complex described and defined by Lieberoth (1963). We suppose that this hiatus is not a regional phenomenon only and could be found in other loess profiles of Central Europe too.

The interpretation of grain size distribution leads to the assumption that there was a successive increase of wind speed during the upper Weichselian loess sedimentation to its maximum at approximately 20 ka.

This study shows that loess-paleosol sequences are a useful archive for high resolution landscape and environmental reconstruction. However, an age control by absolute dating methods is important regarding to the high potential of erosion in loess landscapes which cause hiatuses.

References

1. Lieberoth, I. (1963): Lößsedimentation und Bodenbildung während des Pleistozäns in Sachsen. – Geologie 12: 149–187.
2. Haase, G., Lieberoth, I. & Ruske, R. (1970): Sedimente und Paläoböden im Lößgebiet. – In: Richter, H., Haase, G., Lieberoth, I. & Ruske, R. (Eds.): Periglazial – Löß – Paläolithikum im Jungpleistozän der Deutschen Demokratischen Republik. – VEB Hermann Haack, 274: 99–212.

SOME ANALYTICAL INDICATORS OF BURIED SOILS AS A REFLECTANCE OF ENVIRONMENTAL CONDITIONS OF PEDOGENESIS‣

Ovsepyan R.A.[1], Gugalinskaya L.A.[2]

[1]Moscow State University, Faculty of Soil Science, Russia, ovsepyanru@mail.ru
[2]Institute of Physicochemical and Biological Problems of Soil Science of the RAS, Russia, gugali@rambler.ru

The study of variations of isotopic composition of elements in rocks is widely used in sedimentary geology, because existence of deviations of various sizes in variation curves of these elements indicates their changes in natural cycles. In addition, the deviations serve as good markers for development of correlation constructions of natural events. The results of research of variations in carbon isotopic composition of buried soils for paleogeographic reconstruction purposes can be used to reconstruct paleoclimatic and paleoecological history of soil formation in the Late Pleistocene and Holocene.

The study of buried soils of the Center of East European Plain was conducted on three key sites: Chuvashiya (a series of buried soils in the north-eastern part of the Volga Uplands), Venev and Karpovo (both in the North-Eastern tip of the Central Russian Upland).

$\delta^{13}C$ is –26 ‰ in holocenic (gray forest) soil of Chuvashiya, ratio gets heavier in buried soil-1 ($\delta^{13}C$ is –25 ‰), and –26 ‰ in buried soil-2. Similar picture is observed in Venev pit: $\delta^{13}C$ is minimal (–26 ‰) in the holocenic soil (chernozem), $\delta^{13}C$ increases in buried soils (–24.5 and –24 ‰ in buried soil-1 and buried soil-2, respectively). $\delta^{13}C$ composition of organic matter of humus horizon of holocenic gray forest soil in the Karpovo pit is the lightest of all the studied (–27 ‰), and a little heavier in buried soils (–25 ‰).

Small variation range of carbon isotopic composition in organic matter of soil (up to 2 ‰) indicates small changes in climatic conditions of soil formation in the era of formation of the studied soils, with perhaps a bit more humid conditions of formation of studied buried soils.

Index of chemical weathering CIA ($CIA = Al_2O_3/(Al_2O_3 + CaO^* + K_2O + Na_2O)\cdot 100$), where CaO* is the amount of CaO incorporated in the silicate fraction of the rock) [1] of studied soils varies between 70 and 85 units. It is notable that CIA value in the humus horizon of buried soils appeared to be in the range of 79–85 units. This fact may indicate high intensity of weathering processes in corresponding periods. The formation of these sediments must have happened in relatively humid and warm conditions. Regardless to the geographical proximity of Venev and Karpovo sites, different CIA indexes in humus horizons of holocenic soils indicate differences in the conditions of formation of soils in Venev and Karpovo.

For instance, chernozem soil in Venev (CIA = 79) were formed on a more weathered parent rocks, than gray forest soil of Karpovo (CIA = 70). Gray forest soil in Chuvashiya (CIA = 72) were formed under conditions similar to the formation of gray forest soil in Venev.

Thus, our research detected that buried soils examined in pits of Chuvashiya and Karpovo were formed on relatively more weathered parent rocks than holocenic soils of these sites. At the Venev site the formation conditions of buried and holocenic soils were similar to each other.

References

1. Nesbitt, H.W., Young, G.M., 1982. Early Proterozoic climates and plate motions inferred from major element chemistry of lutites. Nature Vol. 299, pp. 715–717.

‣The project is supported by RFBR grant № 11-04-01083 «Cyclic recurrence in the development process of litho-, cryo- and pedogenesis in the Late Pleistocene on the Russian Plain».

PEDOGENESIS ON PERIGLACIAL AREA OF CENTRAL RUSSIAN UPLAND IN EARLY VALDAI TIME

Pushkina P.R., Sycheva S.A.

Institute of Geography of Russian Academy of Sciences

Nowadays the interest to the detailing of landscape and climatic events of the past is rising permanently. Soil records in profiles on watershed plains are less informative, then the combination of soil and sedimentary archives of accumulative and trans-accumulative landscapes (slopes, paleodepressions and paleocuts) (Sycheva et al., 2007). This is due to compression of information in profiles of watershed plains, where several events are recorded in the volume of sediments (deposits) of limited thickness, forming one single composite pedocomplex. It's different from an infill of the paleocuts, where paleosoils of different interval are separated from each other by sediments and form pedolithogenic series or pedolitocomplex (Sycheva, 2008). Paleoecological and climatic records are more complete in the last case, and their interpretation is easier and more reliable. Therefore the investigation of paleocuts (buried gullies, hollows and other depressions) is topical for the most full reconstruction of landscapes formation and evolution of pedogenesis in Pleistocene.

The objects of our investigation were fossil soils of Early Valdai interstadials (Kukuev and Streletsk paleosols). Paleosols were formed during two major warmings, next to Mikulino interglacial. The age of soils is about 105–95 thousand years (MIS – Marine isotope stage 5c) and 80–70 thousand years (MIS 5a) respectively. Both soils may be correlated with Krutitsa paleosol of Mezin loess-soil complex in Velichko's stratigraphic scheme (Velichko et al., 1997).

Paleosols were repeatedly investigated in the natural monument «Buried Mikulino-age paleogully in the clay loam Alexandrov quarry» (Kursk region). The first similar investigation was carried out in 1988 on a bottom of paleogully down along the thalweg (after 20 years the pit has moved forward by 0.5 km).

In addition to principal detailed macromorphological description we have provided standard analytical investigation of paleosols: texture analysis, organic carbon content, humus composition, carbonate content. Detailed mesomorphological description of large (20×10×10 cm) undisturbed samples was carried out in the laboratory for the better understanding of paleosols morphology and particular pedogenic processes.

The obtained data and the reconstruction of genesis, evolution and paleoecology of Early Valdai interstadial soils demonstrate, that both of the investigated soils had meadow genesis. They have been forming under wet grasslands, but at the same time under more leaching conditions of upper reaches, than early studied paleosols, located down along talweg of the hollow. Soil formation took place under semi-humid climate of forest-steppe environment under motley grass-meadow vegetation with forest localization in upper course of erosion network. The organization of Early Valdai soil cover in upper course of erosion network corresponds to the modern structure of soil cover in similar conditions.

POLYGENESIS OF MIS3 PALEOSOLS IN CENTRAL AND EASTERN EUROPE: IDENTIFICATION OF PHASES AND UTILIZATION FOR PEDOGENETIC INTERPRETATION

Sergey Sedov[1], Birgit Terhorst[2], Alexey Rusakov[3]

[1]Instituto de Geología, Universidad Nacional Autónoma de México, D.F., Mexico, serg_sedov@yahoo.com
[2]Institute of Geography and Geology, University of Würzburg, Germany
[3]Saint-Petersburg State University, Fac. of Biology and Soil Science, Dept. of Soil Science and Ecology of Soils, Saint-Petersburg, Russian Federation

Recently the MIS3 paleosols have drawn increasing attention as a proxy for reconstruction of paleoenvironments of the initial modern humans dispersal in Eurasia. In fact these paleosols in many cases mark the occupation surfaces of the Late Paleolithic cultures. The paleosol units corresponding to the "Middle Pleniglacial" comprise a prominent element of the profiles within the Eurasian Loess Belt from the Western Europe to Siberia. In some cases these paleosol units are formed by 2 and more paleosols the most detailed profiles demonstrate multiple events of pedogenesis, possibly correlative with Greenland paleoclimate record. However in a number of profiles this paleosol unit is presented by a single paleosol, earlier interpreted as a single event of pedogenesis. We demonstrate in two case studies from the southern and northern parts of the European loess area that Middle Pleniglacial paleosols can have a polygenetic profile where more than 1 event of soil formation could be detected, separated by the phases of geomorphic activity.

In the classic site Stillfried B in Lower Austria the MIS3 paleosol is presented by a brown Cambisol Bw horizon embedded in loess. More detailed morphological analysis on macro- to microscale allowed do detect the following phases of soil development: 1) formation of leached weathered reddish Cambic horizon enriched in clayey fine material and ferruginous pigment, underlain by Calcic (carbonate-illuvial) horizon with abundant and variable calcitic pedofeatures 2) development of AC horizon with strong granular – lenticular cryogenic and biogenic microstructure and frequent biogenic carbonate concentrations (earthworm casts, terrestrial mollusk shells). These pedogenetic phases were interrupted by the period of geomorphic activity when the Cambic horizon was destroyed and mixed with loess. In the resulting paleosol profile it is present only in the form of redeposited clasts.

In the Upper Volga Basin of Central Russia the northernmost variants of MIS3 paleosol were found being developed of glaciolacustrine sediments and overlain by Late Glacial loessic material In the sections Koskovo these paleosols are presented by deformed gleyed humic Ag horizon, strongly gleyed G horizon and peaty H horizons. Under the microscope peat materials demonstrate high grade of frost fragmentation and deformation as well as mixing with the mineral particle, whereas ferruginous pedofeatures of Ag and G horizons are much less disturbed. Radiocarbon dating showed older age of peat (50 C14 ka BP) compared to humus of Ag horizon (36 ka BP). We conclude that at least 2 stages of hydromorphic pedogenesis could be detected in the "Middle Valday" paleosol unit: older Histosol and younger Umbric Gleysol, interrupted by a cryoturbation/solifluction phase which strongly affected the oldest Histic horizon.

Identification and pedogenetic interpretation of the individual soil formation events within the polygenetic MIS3 paleosols could help more detailed paleoecological interpretation and allow reliable correlation with other regional and global records

THE DYNAMICS OF LATE PLEISTOCENE LOESS FORMATION ON SOUTH OF WEST SIBERIA.

Anna O. Sizikova, Valentina S. Zykina

V.S. Sobolev Institute of Geology and Mineralogy SB RAS, Novosibirsk, Russia, sizikova_a@ngs.ru

Sections of the Late Pleistocene loess-soil sequence are widespread in West Siberia. This sequence consists of 3 loess layers (Bagan, Eltsovka and Tulino) and 2 pedocomplexes (Iskitim and Berdsk). Both Bagan and Eltsovka loesses are included in Sartan horizon and equal to MIS-2. The first lies directly under the Holocene soil, and the second one lies on deposits of the Karga interstadial (MIS-3). The Tulino loess conforms to MIS-4 and covered by Iskitim pc deposits. Below the Berdsk pc is found. It correlates with MIS-5 and unifies soil formations and subaerial sediments of the Kazantsevo interglacial [1].

To conduct the complex study the Lozhok section was chosen, as it is a key section for Late Pleistocene loess-soil sequence of Novosibirsk Priobie. All horizons of the Late Pleistocene loess-soil sequence are presented in this section [2].

Complex of methods we used includes sand quartz grain morphoscopy, elemental ratios Ba/Sr, Sr/Ca, Mg/Ca, Mg/Sr, detailed bulk chemical and grain-size analysis, magnetic susceptibility.

Sand quartz grain morphoscopy [3] revealed that layers under study were formed by aeolian processes. It is confirmed by all-round micropitted texture of grain surface, sufficiently high coefficient of roundness and degree of surface dullness. Also cryogenic processes took part in their formation: there are typical conchoidal fractures on the majority of grain surfaces.

These facts prove that these Late Pleistocene loess layers were formed in conditions of periglacial environment (dry cold deserts). Elemental ratios Ba/Sr, Sr/Ca, Mg/Ca, Mg/Sr demonstrate a higher values in soil deposits and lower values in loess layers. These ratios are inversely proportional to magnetic susceptibility. Frequency dependent magnetic susceptibility (X_{FD}) revealed in each loess layer the presence al list of three peaks of higher values. These peaks are also fixed by elemental ratios and by distribution of Fe_2O_3 and CaO. Data obtained by bulk chemical analyses show decrease of Fe_2O_3 and Al_2O_3 and increase of CaO content from the Suzun loess (MIS-6) to the Bagan (MIS-2). It argues that the climate of cold and arid epochs from 130000 to 10000 yr has been gradually coming drier and colder. The distribution of fine-grained sand and coarse-silt fractions and the mean grain size rises from the Suzun loess (MIS-6) to the Bagan one (MIS-2). It is the evidence of environment activity intensification from the Suzun loess accumulation period to the Bagan (from MIS-6 to MIS-2). The wind strength expressed by U-ratio also confirms the intensification of environmental dynamics to the Last Glacial. It goes with data of higher loess accumulation rate during that time [4]. Thus, all data obtained reveal the presence of paleoclimatic variations during each loess accumulation period of the last 130000 years. There are several clear short-term periods of insignificant humidification of climate, during which the wind strength also reduced. It is the evidence, that the tendency of aridization and cooling was not constant.

The study was supported by RFBR Grant № 12-05-31414.

References

1. Zykina V.S., Zykin V.S. Loess-soil sequence and evolution of paleoenvironment and climate of West Siberia during Pleistocene // Novosibirsk: "Geo", 2012, 477 p. (in Russian)
2. Volkov I.A. Late Quaternary subaerial formation, – Moscow: Science, 1971, – 254 p. (in Russian)
3. Velichko A.A., Timireva S.N. Morphoscopy and morphometry of sand quartz grains from loess and paleosol layers // Paths of evolutional geography path (Results and Views). Moscow: IG RAS, 2002, 170–185 pp. (in Russian)
4. Sizikova A.O., Zykina V.S. Late Pleistocene loess layers of south part of West Siberia – evidence of cold epochs. // Paleontology, stratigraphy and paleogeography of Mesozoic and Cenozoic of boreal regions, Vol. II. Cenozoic. Materials of scientific session devoted to 100nd birthday of V.N. Saks, 18–22 of April 2011, Novosibirsk, IPGG SB RAS, 2011. 159–164 pp. (in Russian)

UNRAVELLING LOESS-PALEOSOL SEQUENCES IN THE KREMS REGION, LOWER AUSTRIA

Tobias Sprafke, Birgit Terhorst

Institute of Geography and Geology – University of Wuerzburg, Germany

Lower Austria is a classic region of loess research and famous for the former type localities of quaternary stratigraphy Paudorf, Göttweig and Krems [1, 2]. A renaissance of research in this region is connected to improving dating methods and the recent demand for landscape reconstructions and paleoclimatic regionalization. Lower Austria is located in an important (paleo-)geographical bridge position between more maritime influenced Western to Central Europe and more continental (South-)Eastern Europe. The loess-paleosol sequences (LPS) in the study area are discontinuous and polygenetic, as they are mostly located in hillslope positions. Detailed paleopedological studies on the macroscopic and microscopic scale are required to reconstruct their genesis. Reliable dating techniques are important to estimate the factor of time for pedogenesis, and to allow for chronologies and correlations.

In the past, the **LPS Paudorf** has been discussed controversial, as it is located downslope and a rather complex paleoenvironmental record [3]. Uneven dust sedimentation rates, redeposition with admixture of local rock fragments, erosion and pedogenic overprinting hamper the straight forward application of paleoenvironmental proxies. Detailed macro- and micromorphological analyses were carried out, in order to reconstruct the genesis of the paleosols/pedocomplexes and the paleoenvironmental conditions during their formation. Twelve luminescence (post-IR IRSL) ages reaching up to 316 ± 27 ka support the interpretations. In the basal loess sediment (MIS 10) a pedocomplex developed during MIS 9 mainly under forest-steppe. Sandloess of MIS 8 is the parent material of a largely truncated (forest-)steppe paleosol of MIS 7. Cryosols in the MIS 6 loess sediment indicate climatic oscillations during the penultimate glacial. The upper pedocomplex is a Chernozem (MIS 5c[-a?]) that developed in a mixture of redeposited Cambisol of MIS 5e, dust and local material.

The up to 35 m thick **LPS Krems-Schießstätte** hosts ~15 paleosols labelled KR 1…15 from top to bottom; the Matuyama-Brunhes Boundary (MBB) was detected between KR 5 and 4 [2]. KR 4 is the only paleosol of the Brunhes sequence with enhanced weathering degree. Several profiles in the vast outcrop are currently investigated to reconstruct the stages of development in the prominent KR 4 pedocomplex and the sequence above. The aim is to interpret the available and the missing record of landscape response to the last eight glacial-interglacial cycles. In the upper part of the LPS, similarities to the Paudorf sequence are visible. Careful attempts of a correlation are supported by first luminescence datings.

Our studies are a first indication that the **paleoclimatic conditions in the study region** were comparable to Central Europe during the last two glacials, whereas the conditions were more similar to the Pannonian Basin climate during the last three interglacials.

References

1. Fink, J. 1956. Zur Korrelation der Terrassen und Lösse in Österreich. Eiszeitalter und Gegenwart 7, 49–77.
2. Fink, J., 1976. Exkursion durch den österreichischen Teil des nördlichen Alpenvorlandes und den Donauraum zwischen Krems und der Wiener Pforte. Mitteilungen der Kommission für Quartärforschung der Österreichischen Akademie der Wissenschaften 1.
3. Sprafke, T., Terhorst, B., Peticzka, R., Thiel, C., *in press*. Paudorf locus typicus (Lower Austria) revisited – The potential of the classic loess outcrop for Middle to Late Pleistocene landscape reconstructions. Quaternary Science Journal (E&G).

PALEOSOL MONOLITHS IN THE COLLECTION OF THE V.V. DOKUCHAEV CENTRAL SOIL SCIENCE MUSEUM (ST.-PETERSBURG)

Sukhacheva E.Yu., Aparin B.F., Rusakova E.A.

V.V. Dokuchaev Central Soil Science Museum (St. Petersburg), Russia, soilmuseum@bk.ru

The Central V.V. Dokuchaev Museum of Soil Science was founded in 1904 and until now it is a keeper of the richest collection of soil monoliths in the world from different regions of Russia and the World. The number of monoliths units in the Museum database exceeds 2.5 thousand. A special place in the collection is occupied by the monolith of buried soils which can be represented by keepers of paleolandscape's memory.

The unique exhibit of a current Exposition of the Museum is the monolith of Mikulian Albeluvisol Paleosol (the age ~125 ka BP) which was dug in the Bryansk City by scientists of the Geography Institute RAS (Moscow) A.A. Velichko and T.D. Morozova during Mikulian Interstade study. This Paleosol monolith was polite passed to the Museum.

The first buried soil monoliths for the Museum's collections were selected by A.L. Alexandrovsky. In the Museum stores have been keeping a set of Albeluvisols buried by tumulus within the village Vilovatovo (Mari-El Republic). In the 1987 the Museum collection was enriched by the monolith of Chernozem buried by tumulus in Azov district of Rostov Oblast (the authors are B.F. Aparin and B.B. Karryev). Thanks to scientific collaboration with Institute for the history and material culture RAS have been selected buried soil monoliths from the excavation sites of archaeological monuments “Kostenki-14” (the monolith was dug by A.A. Sinitsyn) and “Kostenki-1” (the monolith was dug by B.F. Aparin).

Substantial interests for scientists attract the Palesol monoliths from south coast of Ladoga Lake which have been collected by Museum researches during the last years. They are represented by series of Podzols buried by Ladoga Lake deposits:

- ✓ Humus-illuvial Podzol buried by the sandy deposit with the thickness of 2.5 m in the outcrop of the River Shotkusa (radiocarbon data 5160 yr BP);
- ✓ Buried Fe-illuvial Podzol formed at the depth of 130 cm and overlain by modern Fe-illuvial Podzol within lake-glacial plain nearby the mouth of the River Svir;
- ✓ Compound and heterochronous soil profile composed of the three soils – Entic Podzol on buried peat deposit which formed on buried Podzol (coast bank of the Ladoga transgression);

Within mouth of the River Ochta in the central part of the Saint-Petersburg during archaeological excavations were collected some monoliths of the buried Gray-humus and alluvial soils which characterized by different degree of hydromorphic processes.

Monoliths of buried soils dug from the river banks of the River Volchov within the village Old Ladoga contain information of environment conditions of the initial adaptations of this territory more than 800 years ago. These paleosols developed on bluish-gray silt deposits of the Ladoga transgression. Within the soil profile were detected two buried humus horizons. The radiocarbon data of the bottom humus horizon was obtained 4640±150 yr BP and the data of the top humus horizon – 1580±100 yr BP. The age of the soil which monolith was dug on the opposite bank of the Volkhov River within the territory of the Ljubsha ancient settlement is 1770±70 yr BP.

This study was supported by Grant Agency of the Russian Foundation for Basic Research (Projects No 11-04-00392a).

DETAILED LATE PLEISTOCENE PEDOLITHOSRTATIGRAPHY OF OUT-GLACIAL AND ANCIENT-GLACIAL AREAS OF THE EAST-EUROPEAN PLAIN BASED ON A STUDY OF PALEODEPRESSIONS

Sycheva S.A.

Institute of Geography, Moscow, Russia, sychevasa@mail.ru

The most detailed events of Pleistocene and Holocene phases are recorded in the thickest depression forms, embedded immediately before these intervals: in lacustrine and wetland basins, bottoms and slopes of the valleys, beams, ravines. The watersheds sections keep the integral records of the events, while paleodepressions preserve the detailed, high-resolution records of climatic fluctuations of different orders.

Interglacial (MIS 5e) Ryshkov pedolithocomplex (rank 5) occurs at a base of the Late Pleistocene sediments of periglacial and ancient glacial areas of the East European Plain, at the bottoms and on the lower slopes of paleodepressions. Its formation took place during three to four phases of soil formation, separated by morpholithogenic phases. The final stage was a catastrophic one – a strong fire and post-fire erosion. The soils of the first phase were meadow and meadow-chernozem, the second and third phases are represented by sod-podzolic soil (Albeluvisol). Polygenetic soils have been developed on watershed (rank 4). The major soil types were Albeluvisols and Luvisols. Ryshkov paleosols is the simplest on the slopes, having well-developed profile with textural differentiation, which allows to identify it as sod-pale-podzolic soil.

Seym diluvial-solifluction sediments up to 5 m thick have been accumulated in paleodepressions during the Seym stadial (MIS 5d) – the first major Early Valdai cooling. Cryogenic textures, cryogenic patterns and small erosional forms are characteristic.

Two interstadial soils – Kukuev, rank 2 (MIS 5c) and Streletsk, rank 3 (MIS 5a) have been formed in the early Valdai under relatively warm environment. These soils are separated by deluvial deposits, fixing the cooling period – Mlodat' stadial (MIS 5b). Each of these interstadial soils has been formed in two phases: first was meadow or chernozem-meadow phase, last stage corresponded to gray, dark gray forest soils.

Early Valdai period terminated by major cooling (beginning of the pleniglacial) named Selikhovodvor stadial (MIS 4) with the accumulation of diluvial-solifluction deposits. Aggradation of permafrost and the formation of large pseudomorphs following the massive vein ice occurred at that time.

Aleksandrov (rank 2) and Bryansk (rank 3) interstadial soils have been formed in Middle Valdai (MIS 3) period. They are separated by diluviual-solifluction deposits (Tuskar' stadial). Bryansk soil is compex one, composed of the Monastery and actual Bryansk soils. ^{14}C-age of the Alexandrov soil is ~50 kyrs BP, Tuskar' deposits – 39–40 kyrs BP, Bryansk soil – 33–23 kyrs BP.

Bryansk soil has been deformed by cryogenic processes during the maximum glaciation time (MIS 2). Late Valdai loess has been accumulated later mainly by aeolian and diluvial processes. Few weakly developed (embrional) paleosols (rank 1) have been formed in the Late Valdai (MIS 2) stage, reflecting the least climatic cycles of the late Pleistocene.

Thus, the Late Pleistocene of the periglacial area of the East European Plain appears to be much more complex structured than it is represented in the commonly accepted schemes.

Above presented detailed sequence of the Late Pleistocene events is consistent with the detailed archives of ice cores, sea, ocean and lake sediments. High-resolution stratigraphic scheme of the Late Pleistocene correlates well with the high-resolution archives of glacial regions of the East European Plain, pedosedimentary records of the Europe and Eastern Siberia. Dedicated paleosols correspond to the interstadials: Mikulino – Eemian interglacial, Kukuev = Brorup + Amersfoort = St. Germain 1 (~115–105 kyrs BP), Streletsk = Odderade = St. Germain 2 (70–80 kyrs BP), Alexandrov = Oerel (~55–50 kyrs BP); Kostenki low soil (14-II) = Moersfoold = Poperinge = (44–45 kyr BP), Hydrouzel soil and Tuskar' gley loams = Hengelo (38–40 kyr BP), Monastyrsk and Bryansk = Denekamp (30–25 kyr BP).

This research is supported by RFBR grant 11-05-01046.

HIGH RESOLUTION LOESS RECORDS DURING THE MIS2/3 TRANSITION

Terhorst B.

Loess-paleosol sequences (LPS) record regional developments of Quaternary climate changes, which are decidedly recorded in global temperature curves. For the last glacial the NGRIP ice core (NGRIP members 2004) with the GICC05 time-scale provides a largely continuous annual record of frequent stadial-interstadial oscillations for the period 15 to 42 ka (Andersen et al. 2006). This time span constitutes a period characterized in different types of archives by numerous paleoclimatical and paleoenvironmental fluctutations. The response of geosystems to such changes is of major interest for the human-environmental interaction during the time of occupation of an archeological site.

In general, in the loess regions of Austria and Germany paleopedogenetic and paleoenvironmental studies are conducted by the use of a multi-methodological approach. Investigations, which concentrate on the MIS 3/MIS 2 transition reflect that paleopedogenesis changes relative to sedimentation rates, and the topographical position is of major importance for pedogenetic processes. Through the sequences, processes related to permafrost conditions were active during the upper MIS 3 as well as during the MIS 2 as proved by numerous cryic/stagnic soil horizons.

For the upper part of MIS 3, a distinct paleosol can be identified in European loess sequences. In Germany it is designated as Lohne Soil, whereas in Austria or the Czech Republic (Dolní Věstonice) it is referred to as Stillfried B or as PKI. With increasing continental climate to the East and Southeast, interstadial soils are difficult to detect by field methods. In this context, paleosols designated to Stillfried B consist of a series of very weakly developed and initial horizons at its key section in E Austria, whereas the more humid areas in NW Austria record a well-developed paleosol for the upper Middle Würmian (Terhorst et al., 2002). The chronology of this pedocomplex, as well as its interregional and global correlation is still under discussion. The Lohne Soil or the Stillfried B interstadial soil could not be proved so far for the western part of Lower Austria. Relevant loess-palaeosol sequences, such as in Willendorf or Stratzing show an alternation of several weak and thin paleosols and grayish cryic horizons. In this context, the time scale of the Krems-Wachtberg archeological site is of major relevance for paleopedological and pedostratigraphical approaches an is presented in detail.

The climatic degradation during MIS 2 shows loess sedimentation, partly redeposition, as well as the formation of Cryosols, formed under permafrost conditions in all sequences. The corresponding paleosols are best developed in the profiles of the humid loess regions, for instance of NW Austria. Transitional regions also reflect intense stagnic/cryic soil environments but less developed as in the humid loess areas. However, signs of pedogenesis are clearly present in the thin soil horizons, which record significant peaks in the environmental magnetic curve. We interpret these results as a signal of short term stagnic/cryic soil forming processes related to higher sedimentation rates.

The dry loess regions, here represented by the East of Lower Austria, show that stagnic/cryic processes become weaker, a fact which could be best explained by the interplay between high sedimentation rates and dryer paleoclimatic conditions.

The presentation give an overview on selected loess-paleosol profiles and compares them to further relevant paleo-archives s to the NGRIP curves.

EVOLUTION OF PEDOGENESIS ON THE EAST EUROPEAN PLAIN DURING QUATERNARY GLACIAL-INTERGLACIAL CYCLES

Velichko A.A., Morozova T.D.

Institute of Geography RAS, Russia, paleo_igras@mail.ru

A succession of Interglacial, Interstadial and Pleniglacial soils within Pleistocene glacial-interglacial macro cycles (Table 1) was determined by differences in heat and moisture supply, pedogenic processes and sedimentation rate.

Interglacial pedogenesis was changing from subtropical during the Early Pleistocene (Balashov and Rzhaksa soils) to subboreal and subsequent shift to boreal in the Middle and Late Pleistocene. Subboreal forest soils with well-developed texture-differentiated profile and cutan complex predominate in the central part of East European Plain during interglacials of Middle and Late Pleistocene. In Southern areas of East European Plain humus-accumulative prairie soils predominate during Mikulino and Likhvin Interglacials (Inzhavino and Mezin pedocomplexes).

Features typical to subtropical pedogenesis in the sections of Central part of East European Plain first appear in soils of Vorona pedocomplex (Muchkap Interglacial). They can be traced in the soils of similar age further south up to the Sea of Azov.

Interstadial dark-coloured soils together with Interglacial soils form a separate group of heterochronous and heterogenic pedogenesis. They are typical for various epochs of the Pleistocene and represented by composite pedocomplexes. Interfacial pedocomplexes formed during the early warming intervals at the beginning of glacial epochs. Soil pattern during Interstadials was characterized by high homogeneity and reduction of zonal contrasts with predominance of humus-accumulative soils.

Pleistocene units in glacial and periglacial areas in Eastern Europe

Compiled by A.A.Velichko, V.V.Pisareva, T.D.Morozova, O.K.Borisova, M.A.Faustova, Yu.N.Gribchenko, V.P.Nechaev, S.N.Timireva, V.V.Semenov

Evolutionary Geography Laboratory, Institute of Geography RAS, Moscow

West European glacial area			East European glacial area			East European periglacial area		MIS Var. 1	MIS Var. 2
Holocene								1	1
Weichselian glaciation		Late Weichselian	Valdai glaciation		Late Valdai		Altynovo loess	2	2
							Trubchevsk soil		
							Desna loess		
	Middle Weichselian	I/s Denekamp		Middle Valdai – Bryansk megainterval	I/s Dunaevo		mild stage	3	3
					Shenskoye cooling		cool stage		
					Leningrad warming		mild stage		
		Cool and warm stages			Kashin cooling		cool stage		
							warm stage		
					Krasnogorsk warming		temperate stage		
	Early Weichselian	Cool and warm stages		Early Valdai	Early Valdai stages		Khotylevo loess	4	4
		I/s Brorup			I/s Upper Volga (Krutitsa)	Mezin soil complex	I/s Krutitsa soil	5	5
		Cool and warm stages			Early Valdai stages		Sevsk loess		
Eemian Interglacial			Mikulino Interglacial				Salyn interglacial soil	5e	5e
Saale glaciation		Warthe (Saale III) stage	Dnieper glaciation		Moscow stage		Moscow loess	6-8	6
		I/s Treene			I/s Kostroma		I/s Kursk soil		
		Saale II (Drente II) stage			Dnieper stage		Dnieper loess: i/s Romny soil; Orchik loess		
		Saale I (Drente I) stage			Interstadial	Kamenka soil complex	I/s Late Kamenka soil		
					Stage		Loess		
Demnits, Wacken Interglacial			Kamenka Interglacial				Early Kamenka interglacial soil	9	7
Fuhne glaciation		Stage II	Glatiation (Pechora?)		Stage		Borisoglebsk loess	10	8
		Interstadial			Interstadial	Inzhavino interglacial soil	I/s Late Inzhavino soil		
		Stage I			Stage		Loess		
Holstein Interglacial			Likhvin Interglacial				Early Inzhavino intrglacial soil	11	9
Elster glaciation		Elster II stage	Oka glaciation				Korostelevo loess	12	10
		Interstadial							
		Elster I stage							
Cromer complex		Interglacial IV Voigstedt	Ikorets Interglacial ?			Vorona soil complex	Late Vorona soil	13	11
		Stage C	?				Loess	14	12
		Interglacial III	Muchcap Interglacial		optimum 2		Early Vorona interglacial soil (optimum 2)	15	13
					cold stage		cold stage		14
					optimum 1		(optimum 1)		15
		Stage B	Don glaciation				Don loess	16	16
		Interglacial II	Okatovo Interglacial				Rzhaksa interglacial soil	17	17
		Stage A	Setun stage				Bobrov loess *Brunhes*	18	18
		Interglacial I	Krasikovo Interglacial			Balashov soil complex	*Matuyama* Balashov interglacial soil	19	19
			?						
			Akulovo Interglacial						
			Likovo glaciation						

Table 1.

Gley soils with cryogenic features is typical for Interstadial pedogenesis of later phases of glacial epochs. Soils are strongly gleyed through the whole profile and have weakly decomposed humus and ooid type of aggregation of mineral matrix.

Pleniglacial phases of glacial epochs are characterized by the prevalence of sedimentation on pedogenesis and physical weathering on biochemical processes. It was time of predominantly synlithogenic pedogenesis.

COMPOSITION AND STRUCTURE OF THE LOESS-SOIL SEQUENCE OF LATE AND MIDDLE PLEISTOCENE OF WEST SIBERIA

Zykina V.S., Zykin V.S.

Sobolev Institute of Geology and Mineralogy, Sibirian Branch of the RAS, Russia zykina@igm.nsc.ru

Loess-soil sequences of the Quaternary make up the most complete and detailed natural archives of climate and environment events in mid-latitude continental Asia. Loess sediments of about 120 m thick cover vast areas of the forest-steppe and steppe zones of southern West Siberia. Correlation of over one hundred loess-soil sections against soils and pedocomplexes with similar diagnostic features over a large territory allowed us to reconstruct the complete loess-soil sequence of Siberia. The stratigraphic record and evolution of the loess-soil sequence was constructed by geological, paleopedological, paleomagnetic, and biostratigraphic evidence and by ^{14}C and TL dating.

The composition and structure of the loess-soil sequence reflects the general intensity of atmospheric circulation. The loess-soil sequence of West Siberia consists of rhythmically alternated thick layers of loess and complexes of fossil soils interbeded by 1–2 more thin loess horizons. The lower soils of all pedocomplexes as a rule have the more thick profiles, and were thus deposited during the longest and warmest periods. The upper soils of the pedocomplexes have more thin and less developed profiles formed during shorter periods in colder climates. The soil formation stages in the successions differ in the structure of pedocomplexes, in automorphic soil genetic types, and in geographic patterns, which allowed to distinguish diagnostic or morphotypic features for each warm stage. However the steppe and forest-steppe subboreal soil formation dominated in all warm stages of Late and Middle Pleistocene in West Siberia.

The complete loess-soil sequence in Brunhes chron of West Siberia includes ten soil complexes alternated with thick loess layers. Soil formation mostly occurred in periods of weak circulation, whereas loess deposition was associated with active wind transport when the air was thickly saturated with dust. Structure of pedocomplexes in the West Siberian loess reflects the pattern of the global warm stages in which closely spaced warm periods are separated by relatively short cold intervals.

Interregional correlation of climatostratigraphic horizons of the full Pleistocene loess-soil sequence of Siberia with coeval units loess regions of Asia was established distinct synchronism of cold arid and warm humid stages both in zone of west-to-east motion of the atmosphere and in the monsoon circulation zone.

Detailed comparison of the Pleistocene loess-soil sequence of West Siberia, and especially the structure of pedocomplexes in full sections, with odd warm oxygen isotope stages, with the warm stages of the Baikal sedimentary record, and temperature and dust curves from Vostok ice cores in Antarctica attest to the global scale of loess deposition and confirms the common periodicity, trends, and mechanisms of Pleistocene climate change both in mid-latitude Northern Asia and on the Earth as a whole. Spectral analysis of the frequency dependence of magnetic susceptibility (FD) time series reveals the presence of Milankovitch signals at ~100 kyr (eccentricity), ~40 kyr (obliquity) and ~23 kyr (precession) and demonstrates that Siberian loess–paleosol sequences are excellent continental record of long-term paleoclimatic changes.

The comparison of interglacial soils with modern soils, formed in similar geomorphological conditions, reveals larger thicknesses of interglacial Late and Middle Pleistocene soils and more less thicknesses of the Holocene soil horizons. The data obtained evidence that large interglacials, including the last interglacial, were more prolonged than Holocene. It seems that Holocene represent the initial phase of continuous warming.

This research is supported by RFBR grant 13-05-00599.

ALLUVIAL AND COLLUVIAL SOIL-SEDIMENTARY SEQUENCES

MAGNETIC PROPERTIES OF PEDO-SEDIMENTARY SEQUENCES AS PALEO-ENVIRONMENTAL INDICATOR IN SONORA, MEXICO

Hermenegildo Barceinas[1], Tamara Cruz[1], Elizabeth Solleiro[2], Sergey Sedov[2]

[1]Posgrado en Ciencias de la Tierra, UNAM/Ciudad Universitaria, CP 04510, México D.F., México
[2]Instituto de Geología, UNAM/Ciudad Universitaria, CP 04510, México D.F., México

Evidences of climatic change deviating from global tendency in NW Mexico and SW USA during Pleistocene-Holocene transition and findings of pleistocenic mega-fauna and early American population remains arouse interest for new paleo-environment proxies in Sonora. Rock magnetic properties have been measured on a sequence of alluvial sediments and paleosols of two profiles (Hornos 1 and Hornos 2) of the La Playa site. Hornos 1 profile consists of silty alluvial sediments in the upper part, followed by a pedocomplex of two Pleistocene paleosols of moderated development. The fisrt one is composed by 2A, 2Bw and 2BC horizons and the second one by 3Bgk and 3BCgk horizons. Hornos 2 profile consists of silty alluvial sediments in the upper part, followed by two poor developed Holocene paleosols 2AC and 3AC, and alluvial sediments in the lower part (associated with upper sedimentary layer of Hornos 1). Magnetic susceptibility was measured in low and high frequency (χ_{lf} and χ_{hf}) and frequency dependence was calculated (χ_{fd}) in order to know concentration and size of magnetic particles. Also an anhisteretic remanent magnetization (ARM) was applied for knowing content of strong ferrimagnetic minerals. An enhancement in χ_{lf} values was found in 2A and 2Bw horizons of Hornos 1 profile, also χ_{fd} and ARM values indicate an increase in the content of ultra-fine grain ferrimagnetic particles formed by pedological processes. Other χ_{lf} enhancement was observed in upper C horizon of Hornos 2, but low values of the other magnetic properties measured suggest that this maximum is caused by coarse magnetic particles. These particles are mostly inherited from parent material, rather than originated by pedogenical processes. These results indicate that environmental conditions during Late Pleistocene were more humid than nowadays, and favored soil development. Afterwards, during Holocene the area suffered an aridization process that provoked decrease in soil development and increase of geomorphic processes within the area.

HIGH RESOLUTION STRATIGRAPHY OF THE LATEST PLEISTOCENE (EXTREME INUNDATION EPOCH – 16–10 KY) IN SE EUROPE

Andrey L. Chepalyga

Institute of Geography RAS, Russia, tchepalyga@mail.ru

At the end of Pleistocene after LGM abrupt warming and events of Extreme Inundation Epoch (EIE, by Chepalyga 2009) held place: marine transgressions, river megafloods, slope solifluction, interfluvial lake and permafrost melting. These events followed by accumulation of specific **periglacial sediments**:

✓ **marine cryosuspensites** (Lavrushin, Chistyakova, 2009);

✓ **river cryosuspensites** or periglacial (cryo-alluvial) proshosoglatial (Goretzky, 1980);

✓ **lake cryosuspensites** – cryolimnic sediments (Divnogorie paleolake) with close to meter, decimeter, centimeter and millimeter cyclicity layers, possible corresponding to millennial, century, decadal and annual time cycles (Chepalyga et al, 2013);

✓ **slope cryosuspensites** – solifluction loam fans with intercalations of;

✓ **fossil soils** (gleyzem, pararendzina type), represented by Trubchevsk (Laskaux), Lower Divnogorie (Bolling), Upper Divnogorie (Allerod) fossil soil units;

✓ **marine cryosuspensites** of the Caspian Sea (Khvalynean) and the Black Sea (Euxinean) corresponds to the same EIE time.

Geomorphologic units. These sediments are associated with geomorphological objects:

✓ **misfit** (underfit) **valleys** with enorm width up to 3–5 km and more (Dury, 1964);

✓ **macromeanders** (Dury, 1964) – big river channels formed during EIE;

✓ **proterrace** (Chepalyga, 2011) – intermediate river terrace with cryo-alluvial sediments located between I terrace of LGM age and Holocene Flood plain. Proterrace is represented by three different on high and age levels: lower – 5 m, 10–12 ky; middle – 9–10 m, 12–14 ky; high – 15 m, 14–16 ky;

✓ **marine terraces** for example 10 terraces of Caspian Khvalynean basin (Rychagov, 1997);

✓ **relict cryogene microtopography** (Velichko, 1993);

✓ **erosion paleocircuses** incise in valley boards by macromeanders channels (Chepalyga, 2011).

All these sediments and geomorphological units are connected each other by paragenetic interrelationships. Fine sedimentation permits to elaborate detail stratigraphy with resolution ≈2000, 500 years and in future more detail time cycles (Table 1).

Table 1.

Chronology	ky time	MIS stage, substage		River terraces Don, Dniester		Fossil soils embrional, initial		Erosional paleocyrcuses generations	Marine Caspian Sea	
Holocene	10,3	1		Flood plain 3–4 m		Holocene		Recent	New Caspian	
DR-III			a	Proterrace	Lower level 4–5 m	Loess		Little 2–3 km	Khvalynean	Late
Allerod			b			Divnogorie Soil complex	Upper soil			
DR-II		2	c		Middle level 9–10 m		—	Medium 5–6 km		Middle
Bolling	13,5		d				Lower soil			
DR-I ? Lascaux			e		High level 14–15 m	Altynovo loess		Big 10–15 km		Early
	16		f			Trubchevsk soil				
LGM	23		g	I (forest) sandy terrace 12–20 m		Desna loess			Atelean	
Brjansk Interstadial		3				Brjansk soil				

PALEOSOLS, PALEOENVIRONMENT AND EARLY SETTLEMENT IN NORTHERN MEXICO, IN THE LATE PLEISTOCENE-EARLY HOLOCENE

Tamara Cruz y Cruz[1], Sergey Sedov[2], Elizabeth Solleiro Rebolledo[2], Guadalupe Sánchez Miranda[3] and Alejandro Terrazas Mata[4]

[1]Posgrado en Ciencias de la Tierra, UNAM, Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510, México, D.F.
[2]Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510, México, D.F.
[3]Instituto de Geología, Estación Regional del Noroeste, L.D. Colosio y Madrid s/n, Apartado Postal 1039, 83000, Hermosillo, Sonora.
[4]Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510, México, D.F.

In Sonora evidences of the early Paleoindian (13000–10500 Cal BP) occupation have been found in the sites La Playa, Fin del Mundo, El Bajio and El Arenoso, among others. Temperate climate more humid than present at the end of the last glaciation is supposed to promote the establishment of the first settlers in the region. To reconstruct the paleoenvironmental conditions we analyzed pedosedimentary sequences on Archaeological Sites of La Playa and El Arenoso, northwest of Sonora, where identified several soil formation periods alternated with periods of high erosion and sedimentation.

In La Playa the key profile of buried alluvial paleosols for the late Pleistocene–early Holocene was described and called San Rafael Paleosol (SRP) It has a sequence of buried horizons A/Bw/BCk/2BCgk/2Ck, dated by AMS in pedogenic carbonates BCk (14910–14230 cal BP) and charcoal of A horizon (4440–4250 cal BP). The red Bw horizon of SRP shows moderate accumulation of clay and pedogenic iron oxides. Minimum of carbonate content in Bw followed by maximum BCk and 2BCgk horizons indicate eluvial-illuvial redistribution.

The properties of SRP (rubification; accumulation of clay; higher values of magnetic susceptibility, carbonates illuviation, and redoximorphic features in the lower part of the profile) show a more humid environment. This paleosol is overlain by a polycyclic sequence of incipient soils and sediments with morphological characteristics different from SRP, developed during the late Holocene.

In El Arenoso, north of Caborca, described two paleosols formed in alluvial sediments: Cantera profile (CTP) with a sequence C/2Bgk1/2Bgk2/3C/4Bk/4Ck/5Bgk/5BCk/5Ck/6Bk/7Bg and El Arenoso profile (ARP) C/2Ck/3Ck/4C/5C/6Bgk/7Bk/7BC/8C/9Ck. Both paleosols consist of gleyic Bg horizons demonstrating evidence of weathering and neoformation of clay, reductomophic processes and illuvial accumulation of carbonates. These paleosols are also developed during the late Pleistocene (19430 Cal yr BP and 16920 Cal yr BP in carbonates of CTP).

These pedogenetic processes evidence semi-humid paleoenvironment, supporting moderate mineral weathering, rubification, clay formation and reductomorphic processes; together with incomplete leaching of carbonates and their precipitation in the lower part of the profile. These environmental conditions prevailed during the early human occupation in the region. The differences of pedogenic processes in the late Pleistocene to the early and middle Holocene paleosols and younger late Holocene soils, demonstrate clear recent trend towards aridization. The variability of the late Pleistocene paleosols is related to the geomorphological conditions of paleopedogenesis: rubified soils are developed on well drained slopes and alluvial terraces whereas gleyic soils were formed in poorly drained basins.

HOLOCENE FLOODPLAIN FORMATION AND RECENT MORPHODYNAMICS IN THE CAPE REGION (SOUTH AFRICA)

Bodo Damm[1], Jürgen Hagedorn[2]

[1]University of Vechta, ISPA, Vechta, Germany, bdamm@ispa.uni-vechta.de
[2]University of Göttingen, Institute of Geography, Göttingen, Germany, jhagedo@gwdg.de

Floodplain sediments were studied in the Gourits river basin in the semi-arid Little Karoo, South Africa. The investigation resulted in a differentiation into two sedimentation phases. The sedimentation of the older phase starts directly above bedrock, or respectively, coarse gravels of the streamlet. These sediments are composed of interbedded sand, silt, and clay deposits. In part, they are stratified by organic horizons and inclusions. Radiocarbon dating show that the sedimentation during the older phase occurred between 1215 and 875 BP at the base, and 670 and 15 BP at the top of the sequence [1].

The sediments of the younger phase mainly consist of homogeneous fine sand. However, these sediments can also comprise the entire Holocene deposits situated above the current riverbed. The sediments are mainly of modern age and are partly deposits of centennial flood events.

In any case, it is notable that 50–70% in vertical thickness of the floodplain sediments has been deposited over the past ca. 250 years. In contrast, only 30–50% of the sediments were deposited in about 950 years ago. Thus, it can be concluded that a change in discharge and, respectively, of sedimentary conditions must have occurred.

As a result of the study, the context between land use change and fluvial sediment load as a consequence of increased erosion is indicated and could explain the exceptional thickness of the upper sediments within the sequence of floodplain strata. The context between the onset of sedimentation and the start of pastoral farming by settlers after AD 400 supports the hypothesis that the first sedimentation phase was set off or favoured by the degradation of the natural vegetation cover as a result of livestock farming [2]. Later, increased sedimentation resulting from increased landscape degradation due to intensified pasture farming by the European settlers has to be assumed [3].

References

1. Damm, B., Hagedorn, J. 2010. Holocene floodplain formation in the southern Cape region, South Africa. Geomorphology 122: 213–222.
2. Dean, W.R.J., Hoffmann, M.T., Meadows, M.E., Milton, S.J., 1995. Desertification in the semi-arid Karoo, South Africa: review and reassessment. Journal of Arid Environments 30: 247–264.
3. Meadows, M.E., Milton, S.J., Dean, W.R.J., Hoffmann, M.T. 1994. Desertifikation im Bereich der semiariden Karroo, Südafrika – Eine Zusammenschau und Neubewertung. Geoökodynamik 15: 219–242.

RECONSTRUCTION OF GULLY FORMATION IN CONTEXT OF SEDIMENT-SOIL-COMPLEXES IN GERMANY

Bodo Damm, Susanne Döhler

University of Vechta, Institute for Spatial Analysis and Planning in Rural Areas (ISPA) Universitätsstraße 5, 49377 Vechta, Germany

Quaternary sediments occur in wide areas of Central European low mountain areas and characterize the ground surface by covering the underlying bedrock up to several meters. Two main types of Quaternary sediments can be distinguished. First, Pleistocene sediments, that formed under periglacial conditions, second, Holocene colluvial sediments which are assumed to have formed due to human initiated soil erosion processes. Where soil erosion took place slope dells, gully channels and truncated soil profiles remain. Thus, the distribution and structure of Quaternary sediments and soils developed in these sediments provide information on landscape development.

The research area is the catchment of the Rehgraben gully system in Northern Hesse, Germany. The gullies are incised into the steep slopes of the Fulda river valley cutting through Quaternary hillslope sediments into the underlying Bunter Sandstone. The channels are oriented along a Pleistocene preform and reach maximum depths of 20 m. The main channels are 540 m to 1000 m long.

For the present study the distribution of Quaternary sediments in the catchment was mapped with focus on the gully edges, soil profiles and their condition were documented and analyzed. Furthermore, the presence of periglacial coverbeds and/or colluvia at the gully edges provides information on the gully age. First results show, that the gully channels cut through the upper layer, particularly in their lower parts. It is supposed, that gully formation started after the deposition of the upper layer during the Holocene. The upper courses of the gully channels are incised into younger colluvial sediments. It can be concluded that at least the upper parts of the gully system developed in consequence of human land use activity during the Younger Holocene.

The aim of this study is the reconstruction of the pre-holocene surface of the gully catchment. Further, the total capacity of eroded material as well as rates of soil erosion and gully formation will be estimated.

UPPER PLEISTOCENE SOIL-SEDIMENTARY SEQUENCES IN THE GULLY SAZHAVKA NEAR THE STARI KAYDAKY VILLAGE (THE MIDDLE DNIEPER AREA, UKRAINE)

Gerasimenko N.P.

Taras Shevchenko National University of Kyiv, n.garnet2@gmail.com

The reference site Stari Kaydaky which represents all units of the Ukrainian stratigraphical framework [1–2] has been intensely studied in the past [1–4]. Results of the new study of the Upper Pleistocene soil-sedimentary sequences have been obtained (including pollen analysis). Multiple sections exposed in the side ravines of the modern gully (7 km long) show slope and bottom deposits of paleogullies that existed here during the Middle and Late Pleistocene.

At the beginning of the Kaydaky time, intense erosional incision occurred deeply cutting into the thick Dnieper loess which is completely eroded in places. The welded or truncated Kaydaky soils are replaced down the slope by co-eval thick pedocomplexes with the Bt and Bth horizons of forest soil at their base. Pollen complexes of these soils resemble those of the Mikulino. The *Carpinus* and upper *Pinus* pollen zones occur within the thick silty E soil horizons. The upper Kaydaky soil is a leached chernozem formed under forest-steppe. In places, it is overlain by pedosediments of brown forest soils of Pryluky unit, but the Tyasmyn loess-like loam or colluvium (0,2–0,5, up to 1,5 m thick) can also separate the two units. In the sections near the gully mouth, the erosional break has been found, and the 4 m thick loess previously related to Tyasmyn unit, appeared to be the older one. Pollen from Tyasmin unit enables the suggestion on its correlation with the first stadial of the Early Glacial.

On paleoslopes, Pryuky unit is frequently represented by two chernozems, separeted by loess colluvium, or by two pedocomplexes (pl_1 and pl_3). Each of the latter consists of bright B horison of brown forest soil overlain by thin humic soil and, finally, by grey-brown pedosediments. The lower pedocomplex is thicker, and it includes pollen of broad-leaved taxa whereas the upper one mainly includes pollen of boreal trees and herbs. The loess between the Pryluky pedocomplexes (pl_2) was formed under grassland with xeric elements, and it is correlated with the second stadial of the Early Glacial. The pl_1 and pl_3 subunits can correspond to the two Early Glacial interstadials. The Uday loess overlying Pryluky unit is rather thin but very light band enriched in carbonates. The arcto-boreal elements of vegetation firstly appear in pollen spectra from Uday unit.

The most complete pedocomplexes of Vytachiv unit are observed in the sections of the lower reaches of the gully. They consist of three main soils. The lowest dark-brown leached soil is best developed, and, by pollen data, it was formed under open pine forest with insignificant role of broad-leaved species. This soil is overlain by pedosediments and, then, by loess band. The middle Vytachiv brown soil is rather thin but rather rich in Fe-Al sequioxides and in pollen of broad-leaved trees. It is separated by thin loess from the weekly developed humic soil of the Upper Vytachiv. Pollen data indicates that this soil, as well as Vytachiv loess interlayers, was formed under steppe. The Vytachiv pedocomplex is correlated with the Middle Pleniglacial. The Upper Pleniglacial loess sequence is subdivided into the Bug and Prychernomorsk units by the two initial soils of Dofinika unit. The latter correspond to climatic oscillations during the second part of the last glacialtion.

References

1. Veklitch M.F., Sirenko N.A., 1972. Opornye geologicheskie razrezy antropogena Ukrainy. Part III. Kiev: Naukova dumka, 225 p. (in Russian)
2. Veklitch M.F., 1984. Paleoetapnost' i stratotipy pochvennyh formatsiy verhnego kaynozoya. Kiev: Naukova dumka, 202 p. (in Russian)
3. Buggle B., Hambach U., Glaser B., Gerasimenko N., Markovich S., Glaser I., Zoller L., 2009. Stratigraphy, and spatial and temporal paleoclimatic trends in Southeastern/Eastern European loess-paleosol sequences // Quaternary International, 196, p. 86–106.
4. Komar M.S., Prilipko S.K., Krohmal A.I., 2007. K voprosu o granitse srednego i pozdnego pleystotsena lessovo-pochvennoy formatsii Ukrainy (opornyi razrez Starye Kodaky). In: Paleontologichni doslidzhennya v Ukraini. Kyiv: p. 378–383. (in Russian)

PALEOSTAGES OF SOIL FORMATION DURING THE PLEISTOCENE IN THE UPPER OB' RIVER REACHES AS A BASIS FOR STRATIGRAPHICAL SUBDIVISION AND RECONSTRUCTION OF NATURAL ENVIRONMENT

Glushankova N.I., Evseev A.V.

Geographical Faculty, Moscow State University

Detailed complex investigations of reference sections carried out in the Upper Ob'River region (Belovo, Kalistratikha, Srostki, Vyatkino, etc.) allowed us to establish sediment facies, to stratigraphically subdivide sediments, and to correlate sediment horizons. Based on absolute age estimations, paleontological and paleopedological data, the established horizons are chronologically correlated with the Pleistocene time scale. Also, the main trends in pedolithogenesis during Pleistocene epochs with different heat supply and evolution of soils are reconstructed. At least 9 horizons of full-profile soils and soil complexes are established in the Pleistocene history of the territory. In general, they correspond to 6 genetically different epochs of intensive soil formation. During the first epoch (about 600–530 ka), formation of the Early Pleistocene soils took place in the steppe and forest steppe landscapes on the slightly eroded alluvial plain. The second epoch (about 400–350 ka) is distinguished by development of automorphous soils on the watershed area. These soils combine the features of dry steppe soils (corresponding to the early stage in profile development) and meadow soils (later stage in profile evolution). The third epoch (about 250–220 ka) is characterized by appearance of chernozems. During the fourth epoch (140–125 ka), slightly salinized soils were formed, and paleosoils with profiles A1, BCa, C similar to the modern leached chernozem and meadow chernozem occupied steppe regions on the plains. During the fifth epoch (about 90–60 ka), soil formation was restricted to forest steppes on the watershed areas. Paleosols formed during the sixth epoch (about 50–30 ka) occurred in meadows and steppes on erosional plains. Profiles of these paleosols are clearly differentiated into horizons A1, AB, Bca, CCa. The modern (Holocene) soil cover of the Upper Ob'River region corresponds to the new stage in soil formation, when watershed surfaces are covered with common and typical chernozems, while depressions and river terraces are occupied by meadow soils and chernozems. Formation of genetically similar Pleistocene soils during certain Pleistocene epochs was characterized by formation of homogenous soil profile with similar combination of properties governed by association of elementary soil processes. Differences between soils are realted to diverse correlations between intensity of soil processes. However, combination of processes remained similar in genetically allied soils.

The research was supported by the Russian Foundation for Basic Research (project 12-05-00372).

PALEOPEDOLOGICAL RECORD OF ENVIRONMENTAL CONDITIONS AT THE BEGINNING OF LATE GLACIAL DUNE FORMING PHASES IN CENTRAL POLAND

Michał Jankowski[1], Paweł Zieliński[2], Robert Sokołowski[3]

[1]Nicolaus Copernicus University, ul. Lwowska 1, 87-100 Toruń, Poland mijank@umk.pl
[2]Maria Curie Skłodowska University, al. Kraśnicka 2cd, 20-718 Lublin, Poland,
[3]University of Gdańsk, al. M. Piłsudskiego 46, 81-378 Gdynia, Poland

The general scheme of chronostratigraphy of Late Glacial dune forming activity in Central Europe is well described in literature. However, several problems still need more detailed studies, e.g. the age and synchronism of aeolian activity initiation, landscape structure during dune forming phases and dividing them periods of land stability and ecosystems development. The aim of this work is to reconstruct environmental conditions prevailing in extraglacial river valleys of selected areas of Poland at the beginning of aeolian phases, on the basis of information recorded in paleosols.

Representative sites located in central part of European Sand Belt, in selected inland-dune areas of Central Poland (the Warta River valley, the Toruń Basin, the Warsaw Basin and the Wieprz River valley), were chosen for studies.

Although datings of dune forming phases on study sites fit to the general scheme of Late Glacial aeolian activity, their start was not synchronous. Time of aeolian activity initiation differed in local scale even more than in regional scale. Dune fields were built during the cold phases of Late Glacial, however, in particular areas individual dunes started to form in the Oldest Dryas, Older Dryas or Younger Dryas. In numerous dunes aeolian sands started to accumulate directly on fluvial sediments, although in other places they covered formerly developed soils. On many sites a series of fluvio-aeolian sediments have been also distinguished as a transitional stratigraphic unit between purely fluvial and aeolian sands. Initial synsedimentary soils occurring in these deposits are an evidence of climate conditions amelioration and initiation of vegetation succession on surfaces of drying up floodplains of extraglacial rivers.

The oldest identified soils formed during warmer phases of Bölling and Alleröd and they represent first stages of development. The soils of Bölling are found very rarely. They are initial Fluvisols and Gleysols related to periglacial tundra landscape. The stage of their development and preservation indicates instability of vegetation and land surface and its sensibility to geomorphological processes. The soils of Alleröd are more widespread and better developed. They represent mostly weakly developed Podzols or Albic Arenosols of subarctic pine-birch forest ecosystem.

Numerous evidences of permafrost: ice wedges, frost fissures, stony pavements, ventifacts have been documented on individual sites. Stratigraphical position of these features suggests a conclusion, that forming of glaciofluvial surfaces, aeolian activity and first soil-forming processes proceeded in periglacial conditions. The final decline of permafrost could not take place earlier than Alleröd.

The study was financially supported by the Polish Ministry of Science and Higher Education, project No: N N306 197639.

PALEOPEDOLOGICAL INTERPRETATION OF THE SOIL SEQUENCE AND BURIED FOREST REMAINS AT THE KOŹMIN LAS SITE IN CENTRAL POLAND

Michał Jankowski[1], Anna Budek[2], Danuta Dzieduszyńska[3], Piotr Kittel[3], Joanna Petera-Zganiacz[3], Juliusz Twardy[3]

[1]Nicolaus Copernicus University, ul. Lwowska 1, 87-100 Toruń, Poland, mijank@umk.pl
[2]Polish Academy of Science, ul. Św. Jana 22, 31-018 Kraków, Poland,
[3]University of Łódź, ul. Narutowicza 88, 90-139 Łódź, Poland

Vertical sequence of soils and sediments developed during Late Pleistocene and Holocene on the river terrace and containing well preserved remains of buried Late Glacial forest has been investigated from paleopedological point of view. The study site – Koźmin is located in Central Poland, in the Warta River Valley, on the territory of the Adamów Lignite Mine.

Three pedostratigraphical units have been distinguished in ca 2.5 m deep profile. The first one represents a peat soil (paleo-Histosol) developed on the surface formed by a periglacial braided river in the Upper Plenivistulian (Würm/Waldai). The peat has been accumulated during younger (*Pinus*) phase of Alleröd and Younger Dryas (GS-1). Remains of subarctic swamp, pine dominated forest (numerous stumps, root systems and fallen trunks of trees) growing on a eutrophic peatbog have been documented at the transition of peat and covering mineral sediments. The second unit is represented by synsedimentary alluvial soil (paleo-Fluvisol) built from fine-stratified deposits of mineral (silty and sandy) and organic character. These sediments covered the older peat soil and remains of the forest, indicating decline of climatic conditions, water-logging and increase of fluvial sedimentation during Younger Dryas. In the light of micromorphological studies organic material included in this unit seems to be derived by erosion partly from the underlying peat and partly from allochtonous sources and redeposited subsequently. The Fluvisol is covered by overbank fluvial sandy deposits accumulated by an anabranching river at the end of Younger Dryas and during Eo- and Mesoholocene. These sediments constitute the parent material of the youngest soil occurring on the contemporary land surface. Actually, this soil can be classified as Arenosol, however it shows clearly relict morphological and chemical features of a Gleysol (oxidized ferrous concretions, high content of manganese). Relict character of that soil is en effect of drainage and lowering of ground water table caused by brown coal mining at the end of the 20th Century.

The presented vertical sequence of hydromorphic soils and sediments reflects a series of local events of water conditions changes related to general changes of climate and paleogeographical environment during Late Glacial and Holocene transition and also to contemporary anthropogenic impact. The results exemplify utility and significance of intrazonal soils for paleogeographical reconstructions not only in local scale but also in over regional aspect.

The study was financially supported by the National Science Centre, project No N N306 788240.

DEVELOPMENT OF ORGANIC SOILS IN RIVER VALLEYS IN KURPIE PLAIN, NE POLAND

Andrzej Lachacz[1], Barbara Kalisz[1], Mariusz Galka[2]

[1] Department of Soil Science and Soil Protection, University of Warmia and Mazury in Olsztyn, Pl. Lódzki 3; 10-727 Olsztyn, Poland, andrzej.lachacz@uwm.edu.pl

[2] Department of Biogeography and Palaeoecology, Adam Mickiewicz University in Poznań, ul. Dzięgielowa 27, 61-680 Poznań, gamarga@wp.pl

Kurpie Plain is nearly flat land formed by fluvio-glacial waters flowing from the melting glacier during Vistulian Glaciation. Narew river valley (right-hand tributary of the Vistula) is a southern border of the region. Numerous tributaries flowing from the lakes located in Mazurian Lakeland are falling into Narew river. The widest river in the region is Pisa in the east part of Kurpie Plain and the longest is Omulew in the west part. Other long rivers are Rozoga and Szkwa. The mentioned rivers are flowing in the former route of fluvio-glacial waters. The river valleys are wide and filled with organic formations (peats, muds and gyttjas), which sometimes contain admixtures of mineral alluvial deposits. In the first half of the twentieth century drainage works had started, and were repeated in the 60 and 70 of the last century. Consequently, the accumulation of organic matter in wetland riverine soils was stopped and organic soils have been subjected to muck-forming process.

In the presented study we focused our attention on organic mud soils, typical for river valleys with a natural hydrological regime. These river valleys used to be flooded in spring and river waters deposited organic and fine-grained mineral sediments. In the late summer, the water level was lowering (frequently 50–150 cm below the surface) and vegetation was growing. The process of decomposition of plant remnants and humification of organic matter occurred as a result of intense microbial activity. Consequently, organic formation, resembling strongly decomposed fen peats, was formed and it was termed telmatic mud. The mud contains 20–60% of organic matter as amorphous humus, and fine-grained mineral fraction from flooding waters. Organic matter is both of allochthonous (humus and plant remnants carried with river waters) and autochthonous (from *in situ* vegetation) origin.

In the studied soil profiles, basic soil properties, plant macrofossils and the age of some soil formations using AMS (Accelerator Mass Spectrometry) radiocarbon dating method was determined. The studied mud soils are of various age. It is related to different depths and origins of land depressions in river valleys. The rate of mud accumulation also varied and ranged between 0.062 and 0.714 mm $year^{-1}$, which is slower than peat accumulation. The studied muds were formed in different moisture conditions, which was proved by the presence of fossil diasporas of water vegetation and water-swamp vegetation (water and rush plant species were present) and which were found at similar depths of the studied soil formations.

INTERACTION OF TIME SEQUENCES AND GEOMORPHOLOGY IN THE SOILS OF THE LOWER MACQUARIE RIVER PLAIN IN SOUTH EASTERN AUSTRALIA

Brian Murphy[1] and David Duncan[2]

[1]Visiting Scientist, Office of Environment, Cowra, New South Wales, Australia
[2]Sustainable Soil Management, Warren, New South Wales, Australia

The alluvial sediments of the Lower Macquarie Plain in south eastern Australia were laid down in a wave fluvial activity dating from the late Pliocene to form a riverine plain. Linear bands of alluvial sediments of different age occur across the landscape. The alluvial sediments were mapped into geological formations of approximately equal age groupings by Watkins and Meakins [1] and the ages of the sediments were determined by thermoluminescence techniques. The soils were mapped originally by Hulme [2] and in more detail by Duncan et al [3]. The soil mapping was strongly influenced by the geological formations and the geomorphological model of sequences of meander plains and backplains within each age grouping of the alluvial sediments. The ages of the sediments strongly influence the features of the soils. The oldest alluvial sediments occur in the Trangie Formation and are 1.6 million to 150 000 years old and the youngest are less than 5000 years old and are associated with the current Macquarie River. The groupings of the alluvial sediments and their associated soils are shown in Table 1.

Table 1. Geological Formations/Soil landscape Groups of Lower Macquarie Riverine Plain

Sediment Group/ Geological Formation	Age, years	Meander Size Flow Regime	System	Main Soils Australian Soil Classification WRB	Clays
Trangie	1.6 million to 150 000	High energy > 2 km	meander plains back plains	Red Chromosols (bright red) (Luvisols, Lixisols) Dark Grey and Black Vertosols (Vertisols)	Kaolinite dominant some illite and minor smectite
Carrabear	150 000 to 15 000	Moderate energy ~2 km	meander plains back plains depressions sand dunes	Brown Chromosols, Sodosols (Luvisols, Planosols, Solonetz) Grey and Black Vertosols (Vertisols)	Variable
Carrabear has a range of provenances supplying sediments - in detailed mapping it is divided into eastern and western groups because of different parent materials in provenances.					
Bugwah	15 000 to 5000	Moderate energy ~1 km	meander plains back plains scalds (lower rainfall), crevasse splays	Red Chromosols, Sodosols (Luvisols, Solonetz) Brown and Yellow Vertosols (Vertisols) Solonchaks in scalded condition	Variable
Marra Creek	< 5000	Low energy < 1 km	meander plains back plains flood basins, lagoons, swamps	Black Dermosols (Kastanozems) Stratic Rudosols (Fluvisols) Black Vertosols (Vertisols)	Smectites and illites common

The data from the soils in the area provides an example of the effect of age of soils on soil properties.

References

1. Watkins, J.J. and Meakin, N.S. (1996). Nyngan and Walgett 1:250 000 Geological Series SH/55-15 & SH/55-11: Explanatory Notes, viii + 112 pp. Geological Survey of New South Wales, Sydney.
2. Hulme, P. (2003). Glovebox guide to the soils of the Macquarie and Bogan floodplain. Sustainable Soil Management, National Heritage Trust. Macquarie 2000.
3. Duncan, D., Wooldridge, A., Brennan, N., Agar, B., Murphy, B., Welch, A., Andersson, K., Kellett, J., Lawrie, J., Kew, G. and Andersson, K. (2008) Soil Information Package, Nyngan 1:250 000 Sheet. Central West Catchment Management Authority and NSW Department of Environment and Climate Change.

ORIGIN AND EVOLUTION OF ALLUVIAL AND DELUVIAL SOILS IN NORTH-EASTERN POLAND

Mirosław Orzechowski[1], Sławomir Smólczyński[1], Jacek Długosz[2]

[1]Department of Soil Science and Soil Protection, University of Warmia and Mazury, Plac Łodzki 3, 10-927 Olsztyn, Poland
[2]Department of Soil Science and Soil Protection, University of Technology and Life Sciences, Bernardynska St. 6, 85-029 Bydgoszcz, Poland

Introduction and methods

The area of northern Poland was shaped during Vistula Glaciation (about 11 700 years ago) and represents young glacial landscape. The origin of Holocene alluvial and deluvial soils is related to the relief, hydrological and climatic conditions as well as human activity. The research was carried out by catena method in the landscape of ice-dammed lakes origin, in morainic landscape, in Łyna river valley as well as in Vistula and Pasleka deltas. The aim of the research was to examine the origin and directions of the evolution of alluvial and deluvial soils in young glacial landscape of north-eastern Poland.

Results

The obtained results of radiocarbon dating of fossil peat soils revealed that the accumulation of deluvial deposits in the zone of ice-dammed lakes origin began in Subboreal period. The age of 60-cm-deep deposit was dated at 3410 ± 35 years BP. Average rate of accumulation of deluvial deposits was very slow and amounted to 0.18 mm per year. In morainic zone, the beginning of deluvial accumulation was dated from Subatlantic period, 1085 ± 30 years BP, to Subboreal period, 4325 ± 30 years BP. The thickness of deluvial deposits ranges between 65 and 107 cm. The average rate of deluvial accumulation was faster than in the zone of ice-dammed lakes origin and ranges between 0.27 mm and 1.00 mm. The results revealed that the thickness of diluvium and the rate of accumulation of denudation deposits in north-eastern Poland do not depend on the age of accumulation but on deposits texture, slope gradient and local conditions. The scale and time shift of the beginning of accumulation of deluvial deposits are related to the selected overtaking of land for agricultural purposes. Therefore, the evolution of deluvial soils is directed at the development of deluvial layers. The accumulation of alluvial sediments in river valleys of north-eastern Poland in Holocene occurred with various intensity. In Łyna river valley the deposition of alluvial sediments on fossil peat soils began in Atlantic period, approximately 5720 ± 40 years BP. These sediments are now 100 cm thick. In delta landscape, alluvial sediments on peats began accumulating much later. In Vistula delta the deposition began 2850 ± 35 years BP and in Pasłęka delta 2190 ± 30 years BP. It is the end of Subboreal and the beginning of Subatlantic period. The thickness of alluvial layers in delta landscape ranges between 80 and 86 cm. The estimated accumulation amounts to approximately 0.30–0.37 mm per year and is similar in Vistula delta and in Pasłęka delta. In Łyna river valley the average year accumulation of alluvial deposits was slower and amounted to 0.18 mm.

HOLCENE PALEOPEDOLOGY OF PRAIRIE CANADA: SYNTHESIS OF RESEARCH AND SOME INTRIGUING QUESTIONS THAT ARISE

Daniel Pennock

Department of Soil Science, University of Saskatchewan, Saskatoon, Saskatchewan, Canada

The Prairie region of Canada has well expressed regional soil zonation – similar in many respects to the landscapes where the fundamental concepts in soil geography were developed by the great Russian pedologists of the 19th and early 20th centuries.

The landscapes are young by global standards – the southernmost part of the Canadian

Prairies were ice-free by 18,000 yr B.P.; by 11,000 yrs B.P. the ice margin was north of the zone now occupied by Chernozemic soils; and the whole region was ice-free by 7000 yrs B.P. The southern land-surface and the soils that formed on them were profoundly affected by climate change in the Holocene. Numerous studies into climatic trends during the Holocene in the Northern Great Plains of North America have been done using pollen and chemical analysis from lake cores and stratigraphic soil records and broad lines of agreement exist.

The period after deglaciation had a cooler and moister climate than the present and the land cover was mostly spruce and aspen forest (similar to that found in the central and northern regions of the Prairie provinces). Lake sediments reveal a period of fresh water and high water levels in this period. All studies indicate a period of increased temperatures and droughts in the middle of the Holocene (i.e., the Hypsithermal). The onset of the Hypsithermal resulted in increased salinity in lakes and an increase in eolian deposition in soil and lake stratigraphic records. Sources reach different conclusions about the climate after the Hypsithermal – several have found evidence that the post-Hypsithermal climate was somewhat cooler and moister than the present climate but others have concluded that conditions similar to those found historical record.

Many studies on the southern Prairies have detected buried paleosols. A common feature of the paleosol sequence is a relatively well-developed soil located below volcanic ash from the destruction of Mt. Mazama (Oregon) in 7627 ± 150 cal yr B.P. This pre-Mazama paleosol often has more developed horizonation than the soils located in the sediment column above the paleosol. The reasons for the widespread landscape destabilization that lead to the burial of the pre-Mazama paleosol are unknown, which is of concern in this period where the rate of human-induced environmental change is accelerating.

The forested region north of the treeline in the Prairie provinces does not appear to have undergone comparable landscape instability in the Holocene – no paleosols (outside of layer sin eolian sand deposits) have been detected. The reasons for this landscape stability north of the treeline have been little studied.

Paleosols can complicate predictive models of soil distribution on the modern soil surface and have also been shown to strongly effect current hydrological processes. At sites where the soil surface was stable throughout the Holocene, morphological and weathering features that were formed in the pre-Mazama period persist in the soil to the current day. These relict features cannot be attributed to the current soil forming environment, and complicate genetic interpretations and modeling of soil processes.

PALEOSOL RECORDS OF LANDSCAPE EVOLUTION (MIS5-MIS1) FROM SOIL-SEDIMENT STRATA OF CHEREMOSHNIK KEY SECTION (PERIGLACIAL ZONE OF THE EAST-EUROPEAN PLAIN)

A.V. Rusakov[1], A.A. Nikonov[2], L.A. Savelieva[1], A.N. Simakova[3], F.E. Maksimov[1], V.Yu. Kuznetsov[1], S.V. Shvarev[2], M.Yu. Bityukov[1]

[1]Saint-Petersburg State University, Saint-Petersburg, Russia, spp-06@mail.ru
[2]Institute of Physics of the Earths RAS, Moscow, Russia
[3]Geological Institute RAS, Moscow, Russia

Cheremoshnik is one of the most important sections of the Quaternary deposits in the center of European Russia, located within the Upper Volga Basin, on the Borisoglebskaya Upland. After more than 60 years of research some questions of the section interpretation are still under discussion, in particular paleosol units formed within the interval MIS-MIS5 have been never studied in detail and dated. We present paleopedological results from the new exposure within Late Pleistocene beam-type terrace (~7 m deep) collected over last several years.

At the base of the sequence moraine pebbly loams are found, overlain by a peat-dark humus paleosol and a 10 cm layer of varved clays. Change subaerial into subaqual environment conditions is confirmed by the data on palynological analysis. The glacial sediments are attributed to Moscowian glaciations.

At the depth 6.25–3.50 m a thick unit of gytta interlayered with peat and containing macrorests of woody wetland plants. Pollen spectra demonstrated predominance of the forest vegetation during the whole period of gytta accumulation, having successive phases. Dating of a peat horizon at the 4.3–4.0 m depth by ^{230}Th/U method allowed to attribute it to MIS5 (Mikulino Interglacial).

The Upper Loamy Unit, which overlies the Mikulino deposits is subdivided into layers I–IV. The lowermost VI layer is a pedosediment from the Gb horizon of Bryansk paleosol (MIS3).

At the depth 2.1–2.7 m a thin but clearly identifiable dark humus – gleyed paleosols (Gleyic Cryosol) has the date 16530±380 yr BP and is associated with Trubchevsk soil. Above a gravelly stratum is found which differs however both from moraine and solifluction sediments. It contains redeposited fragments of humus-gleyed soil material dated at 12570±440 yr BP with pollen assemblage indicative of birch open forest with grasses, mosses and ferns. The uppermost layer is a Holocene laminated pedosediment dated at 2630±90 yr BP.

The main new finding of this study are the following:

✓ Incipient subaerial pedogenesis in the beginning of Mikulino Interstadial was followed by hydromorphic stage with Hystosols and organic sediments (reliably dated);
✓ Trubchevsk soil was identified; the site is the northernmost location of this pedostratigraphic unit;
✓ Absence of Valday (MIS4-2) moraine is proven.

This study was supported by Grant Agency of the Russian Foundation for Basic Research (Projects No 11-04-00392a and 13-05-00854a).

LAST GLACIAL ENVIRONMENTS IN S ITALY AS RECORDED IN TWO PALEOSOL-SEDIMENT SEQUENCES, LACUSTRINE AND MARINE SEDIMENTS

Daniela Sauer[1], Lisa Zwanzig[1,2], Annette Kadereit[3], Fabio Scarciglia[4], Achim Brauer[5], Sabine Wulf[5], Riyad Al-Sharif[2], Helmut Brückner[6]

[1]Institute of Geography, Dresden University of Technology, Dresden, Germany
[2]Institute of Soil Science and Land Evaluation, Hohenheim University, Stuttgart, Germany
[3]Institute of Geography, University of Heidelberg, Germany
[4]Earth Sciences Department, University of Calabria, Arcavacata di Rende (CS), Italy
[5]Section Climate Dynamics and Landscape Evolution, GFZ Potsdam, Germany
[6]Institute of Geography, University of Cologne, Germany

During fieldwork on marine terraces South of Reggio di Calabria (Tyrrhenian coast of South Italy) we discovered an alluvial fan overlying the MIS 5.5 marine terrace. Due to strong tectonic uplift of the area (1.3 m ka^{-1}) the alluvial fan has been dissected by a creek so that its internal structure has been exposed, exhibiting the alternation of several sedimentation and soil formation phases. The paleosols are characterized by accumulation of organic matter, bioturbation features and secondary carbonates. They represent Chernozem- and Phaeozem-like soils that very likely formed in steppe to forest steppe environments under continental climatic conditions. Strong carbonate accumulation occurs in the lowermost part of the profile, between 513 and 693 cm. Its thickness and in parts very massive character suggest that enrichment through slope water has contributed to the carbonate accumulation. The soils were analyzed for texture, soil organic carbon (SOC), carbonates, Fe_d, total elemental composition (XFA on fused discs) and micromorphology. The same environmental conditions that are reflected in the paleosols have been reconstructed based on pollen from lake sediment cores of Lago Grande di Monticchio. Its pollen record indicates temperate deciduous forest from 87.98 to 82.73 ka; vegetation fluctuation from 82.73 to 59.00 ka, then *Artemisia* steppe; alternation between steppe (stadials) and wooded steppe (interstadials) from 59.00 to 25.90 ka; and again open steppe from 25.90 to 14.30 ka (LGM). Organic matter of the two uppermost Lazzaro paleosols has been ^{14}C-dated. Their humus is 26.7–28.7 and 28.8–30.3 cal ka old. Thus, the formation of these soils falls into the period for which the lacustrine record indicates an alternation between steppe and wooded steppe. More data on additional soil-sediment profiles are required to check if paleopedological, lacustrine and marine records can be correlated to obtain an integral reconstruction of paleo-climate, -vegetation, -geomorphodynamics and -pedogenesis in the region. Therefore, we checked if such soil-sediment sequences can be found in other places along the Thyrrhenian coast of Calabria, in the particular geomorphological situation described above. Indeed, we discovered a second profile 30 km North of the first one, with embedded paleosols of similar age. Thus, we conclude that Late Pleistocene alluvial fans with embedded paleosols are not an exceptional phenomenon but can be found in several places along the coast which makes them a valuable regional archive of Late Pleistocene environments. However, several problems remain to be solved. First, in some cases it may be difficult to reconstruct the development of an alluvial fan because a considerable part of it has been eroded due to strong tectonic uplift. Second, it is still an open question whether the sedimentation that interrupted the ecologically stable times of soil formation was activated by fluctuations in climate and vegetation cover or by tectonics. The fact that pedogenesis falls into a period of frequent environmental oscillations suggests that the phases of sedimentation are to a certain degree driven by changes in climate and vegetation cover. Another valuable paleo-record for South Italy is the core GNS84-C106 obtained from the Gulf of Salerno, indicating drier and somewhat cooler conditions during the Last Glacial period. We conclude that Chernozem- and Phaeozem-like soils developed during the last glacial period in South Italy in steppe and forest steppe environments.

THE FLOODPLAIN LANDSCAPES BY THE SURARIVER IN HOLOCENE

Solodkov N.N., Lomov S.P.

Penza State University of Architecture and Construction, Russia, niconsol@yandex.ru, stas_lomov@mail.ru

The evolution of the floodplain landscapes in Holocene was closely connected with major climate changes. Climate changes complicated the development of river valleys and caused water regime which influenced the dynamics of the sedimentation processes in floodplains. It was not only the hydrological network that changed, but the floodplains' morphogenesis processes also were subjected to significant transformation; pedogenic and lithogenicrhythms were alternating, and the structures of flora and fauna were changing as well. The studies of Mesoneolithic settlements on the sand dunes and the research of soil formation evolution during the step changing of nature in Holocene make it possible to restore the following events.

Stage I (10 000–8300 years ago), according to S. Sycheva's research [2], was characterized by the accumulation of sediment deposits and increasing amount of water in the Sura. The sedimentary deposits include sand, gravel and clay. That was a time of dune formation in the floodplain and at that period pine forests, floodplain meadows and deciduous woods spread in the low floodplain. Stage II corresponds to the early Atlantic period AT 1 (8300–6200 years ago). The amount of water in the river coincides with the modern one. The soil formation wasn't active due to the lasting process of floodplain material accumulation that was caused by unevenness of season rainfall.On the whole, according to the research by A. Alexandrovsky, in Mesolithic and Neolithic periods meadows and deciduous woods predominated. Due to the weakening of deflation processes, on sandy massifs sod-sandy soils were forming, and in that areas Neolithic settlements were located. Stage III corresponds to the late Atlantic period (AT 3) – 6200–4500 years ago). That period is usually estimated as the best climate because of its high average temperatures (higher than modern ones), low water cutting of the rivers and frequently altering pedocycles (types A–C) in the floodplain strata's of the Sura Basin. At the zonal level forest-steppe and steppe landscapes with sod-sandy leached soil on the dunes were predominating. Stage IV was caused by the warming in early Subboreal period (SB 2 – SB 3) – 4500–2600 years ago. It was characterized by increased thermal resources as compared to the modern ones. In the sedimentary strata of floodplain there form meadow- black earth soils with dates 2330–2370±90 BR IGAN 4214 (having been rejuvenated), as in the Republic of Tatarstanstudied the soils dated as 3150±95 years agoin the floodplain of the river Ulema [1]. On the whole, in that period forest-steppe landscapes predominated. Stage V presented the phase of dampening in Sub-Atlantic period (SA 1) – 2600–900 BC, that was characterized by climate cooling. The middle Sub-Atlantic time (SA 2) reflected the most general warming with alternating micro-pluvial and micro-arid periods of soil formation. In soil profiles in the area of Neolithic settlements some Eluvial horizons A2*l* were developing under the pine-deciduous woods. In the river Minor Cheremshan's floodplain there was a sedimentary strata studied with a layer dated as 1195±60 years ago(KING-619) [1].The current stage (Stage VI) of floodplains' evolution is marked by the increase of sedimentary processes, by burring of previously formed soils and by general climate cooling ("Minor Ice Age") – 800–100 years ago. In the second half of the XX century a marked climate warming is happening. The quantity of warmth is growing, and the same is happening with the amount of moisture in winter, and on sandy dunes complex sod-sandy lessivationsoils' formation is being accomplished.

References

1. V. Mozzherin, S. Kurbanova Activity of the people and erosive channels system of Central Volga area, Kazan, 2004. (in Russia)
2. S. Sycheva. Senturies-old rhythms of the soil forming and relief forming on Central Russian Upland in Holocene. // Izvestiya RAN, Geographical series, 2008, # 3, pp. 87–97. (in Russia)

PALEOSOLS AND PEDOSEDIMENTS OF HUMAN HABITATS

STRATIGRAPHICAL COMPLEX OF BURIED SOILS OF KOSTENKI-1 AND KOSTENKI-12 UPPER-PALEOLITHIC SITES: A RECONSTRUCTION OF PALEOGRAPHICAL CONDITIONS OF ITS FORMATION

B.F. Aparin[1], N.I. Platonova[2]

[1]State Scientific Institution, V.V. Dokuchaev Central Museum of Pedology of Russian Agricultural Academy, Russia, soilmuseum@bk.ru
[2]Institute for History of Material Culture of Russian Academy of Sciences, Russia

Upper-Paleolithic sites Kostenki-1 and Kostenki-12 are situated at the second terrace above the flood-plain of estuary and near-estuary parts of the opposite hillsides of the clough of Pokrovsky Narrow. The range between the bottom of archaeological excavations and eroded surface of Haplic Chernozem is about 450 cm. A comparative study of stratigraphical sections has revealed common typical peculiarities in morphological structure and properties of soils and rocks (as well as in their chemical properties) enclosing cultural debris.

Four suites of the horizon producing together depositional sequences were marked out on the vertical sections of the excavational units. These horizons consist of the horizons-layers distinguished by the color, thickness and their physical composition. Each sequence is culminated in humus horizon. These four sequences correspond with four cycles of sedimentation each of which is defined by gradual changing of layers varied in amount of contained cretaceous gravel and by correlation between loessial loam and calcium carbonate of a various dispersity ratio. The thickness of the layers in sequences ranges from 10 to 50 cm.

The cretaceous outcropping of the clough's steep hillsides and loess, covering its watershed spaces have been the source supply of the sedimentational material. The leading part in transferring loess into the clough was played by deflation (wind erosion), whereas water erosion did not take significant part in transferring fine grained soil.

The depositional sequences had been formed in aqueous environment. The amount of loess incorporated in deposit substantially increases at the close of each cycle due to enhancement of the deflation, which comes along with general climate aridization. The portion of loam significantly prevails over the carbonates in the top layer of each depositional sequence. The organization mechanism of each sedimentation cycle was identical as confirmed by uniformity of morphological structure of all of the sequences. The main distinguishing feature of the deposit series of K-12 is well-defined small-scaled foliation of first and second stratigraphical sequences along with the attributes of deluvial flow of material. These diversities may be explained by the fact that the excavational unit of K-12 is located at the marginal zone of paleoreservoir, nearby the hillside.

Each sedimentation cycle had been substituted by the pedogenesis process. This process proceeded in alkaline reaction of the media under the high content of carbonates. The humus-accumulative process was its main component. Low productivity of herbaceous vegetation, shallow depth of the root area, drainage of the territory, and frigid climate under a small amount of downfalls were its determinative factor.

In the process of evolution of paleolandscapes of the Pokrovsky Narrow the two stages that had been highly propitious for ancient men to settle can be notedly marked out. These two stages accrued to the periods of pedogenesis each of which followed the second and the third cycle of sedimentation.

SOILS OF EARLY SLAVIC SETTLEMENTS AREALS

Dmytruk Yurij Mychajlovich

Y. Fed'kovich Chernivtsy national university, Ukraine, dmytruky@i.ua

Soils of early settlements areals (Raykovecka culture), which in Ukraine is about 500 have been insufficiently studied. On the Prut-Dniester interfluve, where implement our study detected nearly 140 archaeological sites of this kind. Chronologically, they span the period from YII (YII) to X (XI) century AD. These monuments belong to 4 major categories: settlements, gords, burial grounds and places of worship.

A key area (Ridkivtsi), where carried out our study, is characterized by difficult geomorphological terms and vegetation of location earthen shaft and settlement is broadleaved-wood; and at the upper limit of settlement vegetation is meadow (leguminous-mixed grass).

Geographical coordinates of the extreme points: section 7C (meadow): 48°21'53.6" N, 26°01'18.4" sh.d., altitude – 306.7 m; sections of earthen shaft in the forest (1B) – 48°21'53.2" N, 26°00'50.6" sh.d., altitude – 223.5 m.

We have studied such soils: 1) background (sections of 3C –Grey forest gley (Gleyic Greyzems), 8S – Light-grey forest gley (Eutric Podzoluvisols), 1C – Chernozem podzolized (Luvic Phaeozems)), 2) on the site of settlement (5Z, 6Z – Dark-grey forest (Haplic Greyzems)) and 3) buried under the earth mounds (1B, 3B – Brownish-light-grey forest (Eutric Podzoluvisols)).

Age (Uncalibrated) individual horizons are: section 8C (Ehg, 37–58 cm)–1790±80; 1C (A2Ck, 102–111 cm)–2730±80; 5Z (A1g, 32–48 cm)–1250±70; 1B (Ehg, 70–96 cm)–1000±80; 1B (Bkg, 170–200 cm)–10140±150; 3B (Ehg, 66–84 cm)–460±80; 3B (Btg, 84–150 cm)–2440±70.

Soils on the site of settlement have the most artifacts and also have traces of violations of the natural structure profiles. During the time after the burial (about 1000–1200 BP) have found the following major changes in background soils compared with buried: 1) increased thickness of the humus containing horizons and thickness of the profiles of background soils, Ch:Cf, respectively, for the background soils > 1.0; for the buried soils < 1.0; 2) in the upper horizons of background soils are considerably higher levels of coarse dust than in buried soils and is increased profile differentiation of silt – from 1.52–1.63 (buried soils) to 2.18–3.38 (background soils); 3) background soils acidity increased first by lowering of a line carbonates and also due to the intensification of acid hydrolysis as a result of a corresponding change in vegetation; 4) soils on the site of settlements have a significantly higher levels of heavy metals content, as compared with background soils and buried soils, respectively, mg/kg: Pb (19.6–14.7–13.8); Cd (1.11–0.84–0.70); Cu (20.4–15.5–15.0); Ni (29.9–23.2–21.9); Cr (22.9–13.6–14.3); Zn (64.1–43.9–40.6); Mn (614–590–437).

The minimum amount of the mobile phosphorus is in soils buried under earth mounds, and the highest – in the soil on the site of settlement. The amplitude of the phosphorus content is 17 times.

According to the palynological data background soils are forming occurred mainly under broadleaf formations with small arrays conifers forests, that were cut down from ancient times (AP – 68.7%; NAP – 18.7%; spores – 12.6%). Formation of buried soils was occurred in the condition of spread of ferns family of Polipodiaceae, which took the place of the destroyed oak-lime-hornbeam forests (AP – 59.5%; NAP – 7.60%; spores – 32.9%). Attention is drawn to high content of spores of club mosses that coenotic associated with coniferous forests.

So, in general climate of the studied interval was humid and some cooler than modern. The last 1000 – 1200 years was discovered intensification of eluvial-illuvial redistribution and reduce line of location of carbonates as well as increasing the thickness of humus horizons.

Ecological-geochemical status of soils on the site of settlement is changed as a result of human activity: here is an increased average amount of heavy metals and mobile phosphorus.

PALEOPEDOLOGICAL RECONSTRUCTIONS OF THE NATURAL ECOGEOCHEMICAL ENVIRONMENT

A. Evseev, N. Glushankova

Department of Geography, Lomonosov Moscow State University

One of the most promising aspects of paleogeographical reconstructions of ecogeochemical situations based on paleopedology is geochemistry of trace elements in Pleistocene and Holocene landscapes. This allows estimating the possible atmospheric impact on modern soils.

Spectral analysis (atomic absorption) of the modern and fossil soils of different age from forest steppe and steppe landscapes of southern West Siberia revealed comparable concentrations of trace elements giving evidence for similar soil-forming processes. Calculated clarks (KK-1, 1 -1, 6) showed relatively high concentrations of Cu, Zn, Zr, Pb in both fossil and recent soils. In neither of paleosols accumulations of Cu and Pb, the main "pollutants", have been recorded. Concentrations of Zn, Ni, Co, V, Ti, Mn in paleosols correspond to their content in the soil-forming rock, i.e. loess-like loams. Cr and Mo are accumulated in the upper humic-accumulative horizons, while Zr – in illuvial-carbonaceous ones. No evident tendency of accumulation or relative concentrating of any of heavy metals was recorded in recent (Holocene) soils of southern Near-the-Ob-River region located relatively far from industrial sources of pollution.

Slight redistribution of most of heavy metals along the genetic profile, their absence in humus horizons of paleosols, weak processes of self-purification allow using the upper soil horizons as the best indicator of ethnogeny pollution. Intensive pollution manifests itself by considerable accumulation of ethnogeny elements in upper soil horizons. Separation of the natural and anthropogenic processes serves as the basis for forecasting possible changes.

The work was supported by a research grant from the Russian Science Foundation for Basic Research (12-05-00372)

PALAEOMAGNETIC INVESTIGATION OF KOSTENKI 14 AND KOSTENKI 16 ARCHAEOLOGICAL SITES.

Guskova, E.G.[1], Raspopov, O.M.[1], Dergachev, V.A.[2] Iosifidi, A.G.[3] and Sinitsyn, A.A.[4]

[1]SPbF IZMIRAN, St.-Petersburg, Russia, oleg@or6074.spb.edu
[2]Ioffe Physico-Technical Institute of RAS, St.-Petersburg, Russia
[3]All-Russian Petroleum Research Exploration Institute – VNIGRI, St.-Petersburg, Russia
[4]Institute for the History of Material Culture. RAS, St-Petersburg, Russia

Palaeomagnetic studies of sediments of two paleolithic sites Kostenki 14 (Markina Gora) and Kostenki 16 (Uglyanka) situated at a distance of 500 meters from each other in Voronezhskaya region (Russia) have been carried out. Magnetic characteristics of the samples were measured in the Laboratory for Magnetostratigraphy and Palaeomagnetic Reconstructions of VNIGRI. The palaeomagnetic studies of 100 samples of the Kostenki 14 site (Markina Gora) and 17 samples of the Kostenki 16 site (Uglyanka) have revealed the geomagnetic field Kargopolovo and Mono excursions in both cases, which allows us to date the sediments of each of the paleolithic sites as about 42000–24000 years BP.

GEOCHEMICAL STUDY OF VOLCANIC GLASS INCLUSIONS IN ARCHEOLOGICAL AND SOIL SAMPLES USING AUTOMATED SEM DATA ACQUISITION AND TREATMENT ALGORITHMS

O.E. Korneychik[1], B. Solís[2], S.N. Sedov[2]

[1]Technoinfo Ltd., UK; [2]Instituto de Geología, UNAM, Mexico

Appearance of volcanic glass in Maya ceramics of classic period in the settlements, located quite far from volcanoes is an important problem of the Mesoamerican geoarcheology. If one could locate the sources of this glass, interconnect them with the exact eruptions could assist in justification of exact location of ceramics production centers, geography of the trade routes and to check the dating of ceramics and geological samples from those regions. For different monogenetic or stratovolcanoes from numerous eruptions of Central America chemical composition of volcanic glass is very different. During the ceramics production, one can treat glass-containing raw material as a marker to interconnect the time of ceramics production with the time – and the place – of the exact eruption. The main difficulty in this case is the search of the sample regions with the specific morphology and composition, – and that is hard-to-solve in manual operation of the SEM. To solve this task, we have successfully applied automated mineral analysis protocol QEMSCAN, based on the back-scatter electron signal (BSE) and energy-dispersive x-ray fluorescence spectra (EDS) pixel-by-pixel scanning of the sample and assignment of very pixel to exact mineral class basing on best-match principle.

In general, volcanic glass is a mixed Na-K alumosilicate. The matrix for this glass incorporation in case of ceramics is the same alumosilicate, but with different K/Na ratio. Thus, application of EDS analysis for very thin or distorted grains is very nontrivial. Light-weight matrix allows us to more accurately collect the intensities, but in expands the excitation region, that leads to necessity of EDS and BSE combination for such search and allows us to apply the QEMSCAN algorithm.

In comparison with non-SEM based X-ray fluorescence, we can laterally deconvolute spectra basing on sub-micron spacing step and complicated spectra subtraction/deconvolution routine. Thus, we can accurately image and treat glass inclusions, which are sub-micron in of their dimensions.

Acquired statistical data sets allow us to interlink exact eruptions, MAYA settlements and the geochronological scale with higher accuracy due to the external (to the isotopic equilibrium) method of analysis.

WHAT IS WHAT IN THE LOESS-SOIL SEQUENCE AT KRAKÓW SPADZISTA GRAVETTIAN OPEN-AIR SITE – A GEOARCHAEOLOGICAL APPROACH

Maria Łanczont[1], Teresa Madeyska[2], Andrij Bogucki[3], Maryna Komar[4,5], Jarosław Kusiak[1], Przemysław Mroczek[1], Krzysztof Sobczyk[6], Jarosław Wilczyński[7], Bogdan Żogała[8]

[1]Department of Geoecology and Palaeogeography, Maria Curie-Skłodowska University, Lublin, Poland
[2]Institute of Geological Sciences, Polish Academy of Sciences, Warszawa, Poland
[3]Department of Geomorphology and Palaeogeography, Ivan Franko National University, Lviv, Ukraine
[4]National Museum of Natural History at the National Academy of Sciences of Ukraine, Kyiv, Ukraine
[5]Institute of Geological Sciences, National Academy of Sciences of Ukraine, Kyiv, Ukraine
[6]Institute of Archaeology, Jagiellonian University, Kraków, Poland
[7]Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków, Poland
[8]Department of Applied Geophysics, University of Silesia, Sosnowiec, Poland

The Kraków Spadzista street site is one of the best known Middle Upper Palaeolithic sites in Central Europe. Discovered in 1967, it has been regularly studied for 45 years. It consists of several independent units, exposed in trenches with traces of a base camp area, a stone-working workshop and a zone with a concentration of mammoth bones-possibly a dumping area. Its location is probably linked with the peculiar topographic features of the Saint Bronislawa Hill, a hill forming part of the Słowiniec horst and dividing the Vistula River valley from its left-bank tributary, the Rudawa River. In addition, the site is isolated on both sides by small erosion-denudation valleys dissecting the loess cover as well as by the edge of a steep escarpment in the Upper Jurassic limestones. Many years of archaeological studies have revealed a wealth of faunal remains (especially mammoths) as well as numerous Aurignacian, Gravettian and Epigravettian stone artefacts in several cultural layers.

The geophysical and geological/geomorphological surveys carried out in 2012 showed that archaeological layers are separated by carbonate and non-carbonate silty sediments and the entire sequence is underlain by interglacial fossil soil. The intra-loess interstadial soil with the solifluction cover is of key importance because of the accumulation of artefacts occurring there. The loess layer above (about 2.5 m thick) is archaeologically barren. The traces of post-sedimentary deformations and redepositions (deluvial and solifluction processes) are common in archaeological and loess layers making it difficult to unequivocally determine their stratigraphic position and, in many cases, to ascribe artefacts to a specific cultural layer and thus determine their cultural identity.

The physicochemical and micromorphological analysis of loess and heterogeneous loess-like sediments proved their granulometric and lithological diversity, confirming their complex origin and clear/unequivocal links with the bedrock. The results of IRSL dating made it possible to determine their specific chronostratigraphy and establish that the loess-soil sequence studied consists of only some of the stratigraphic sets separated by numerous hiatuses. Based on its typological features and sediment sequences, the bottom soil is interpreted as Eemian-early glacial while the age of the mineral substrate indicates the penultimate interglacial. The cultural layer correlated with Gravettian settlement is dated to the end of the MIS 3 period, while the results of IRSL dating conform to the calibrated C-14 dating of the bones. The palynological analysis of the cultural layer indicates open landscape prevailing at that time, with rather unvaried herbaceous vegetation and groups of coniferous trees in close proximity, primarily *Pinus sylvestris, P.cembra, Larix, Picea, Abies*. The only deciduous tree recorded was a small admixture of *Salix*.

This study was partly supported by projects no 691-N/2010/0 from the Polish Ministry of Science and Higher Education.

LOESSES, PALAEOSOLS/PEDOSEDIMENTS OF MIS 5 IN THE PALAEOLITHIC PRONIATYN SITE ON THE SERET RIVER (PODOLIA, UKRAINE)

M. Łanczont[1], T. Madeyska[2], A. Bogucki[3], O. Sytnyk[4], J. Nawrocki[5], M. Komar[6], J. Kusiak[1]

[1]Maria Curie-Skłodowska University, 2 c,d, al. Kraśnicka, 20-718 Lublin, Poland
[2]Institute of Geological Sciences, Polish Academy of Sciences, 51/55, Twarda Str. 00-818 Warszawa
[3]Ivan Franko National University, 41, Doroshenka Str., 79000 Lviv, Ukraine
[4]Ivan Krypiakevich Institute of Ukrainian Studies, National Academy of Sciences of Ukraine, 4, Kozelnytskaya Str., 29008, Lviv
[5]Polish Geological Institute – National Research Institute, 4, Rakowiecka Str,. 00-975 Warsaw
[6]National Museum of Natural History and Institute of Geological Sciences of the National Academy of Sciences of Ukraine, 15, Bohdan Khmelnitsky Str., 01601Kyiv

The Middle Palaeolithic site in the Proniatyn village (Fig. 1A) has been comprehensively studied for over 30 years. The investigations were carried out in several excavations situated on the Ternopil Plateau and in the near-plateau part of the Seret River valley-side (Fig. 1B, C).

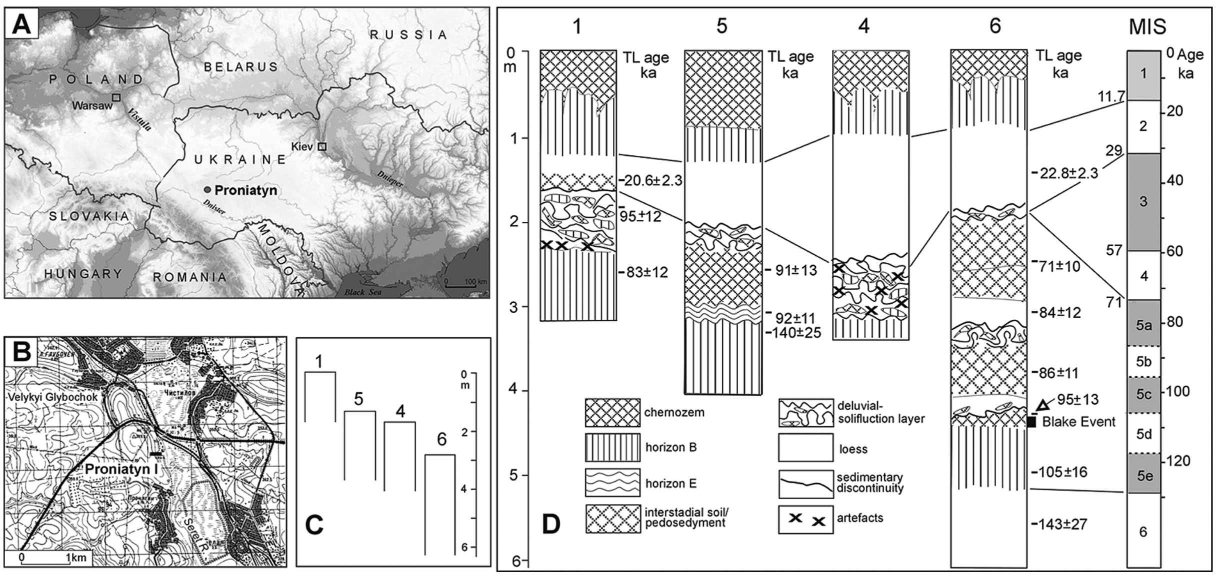

Fig. 1. Geographical situation (A) and topographic sketch (B) of the Proniatyn site. Hypsometric situation (C) and lithostratigraphy (D) of the investigated profiles.

Artefacts in the near-plateau excavations are redeposited and occur within a solifluction layer of complex structure, which was formed in several stages over the Eemian interglacial soil (Fig. 1C, D). The profile 6 exposed in the valley-side in 2011 contains a loess-soil sequence, which is composed of the Eemian soil and 2–3 early-glacial soils from the Last Glaciation, and represents the whole period of MIS 5. This profile was sampled for lithological, palaeomagnetical and palynological analyses, as well as TL dating. Palaeomagnetic anomaly occurring in the Eemian soil probably corresponds with the Blake Event. Interstadial pedogenesis took place in the conditions of continuous supply of material redeposited on the valley-side. That is why the resulting soil units of pedosediment nature are thick and contain high humus content. Each pedogenesis period was interrupted by the development of solifluction and erosion processes and a small accumulation of loess. The picture of plant cover reveals that quite rich steppe vegetation, with the continuous occurrence of trees and shrubs and without subarctic elements, was dominant in the whole early glacial period. The cognition of the complex structure of the early-glacial series gives us a chance to define in detail the stratigraphic position of the Middle Palaeolithic artefacts in the Proniatyn site.

This study was partly supported by projects no 691-N/2010/0 from the Polish Ministry of Science and Higher Education.

CORRELATION BETWEEN THE DISTRIBUTION OF ARTEFACTS AND DEVELOPMENT OF SOILS WITHIN THE MAGDALENIAN SITE IN KLEMENTOWICE (NAŁĘCZÓW PLATEAU, E POLAND)

Przemyslaw Mroczek[1], Jan Rodzik[1], Tadeusz Wiśniewski[2]

[1]Faculty of Earth Sciences and Spatial Management, Maria Curie-Skłodowska University, Lublin, Poland
[2]Institute of Archaeology, Maria Curie-Skłodowska University, Lublin, Poland

The open-air camp in Klementowice is the north-easternmost site of the Magdalenian technocomplex in Europe [1]. It is located in the north of the Nałęczów Plateau that constitutes the northern part of the belt of meta-Carpathian uplands adjoining the belt of Central European lowlands. During archaeological excavations, a total of over 30 thousand artefacts were discovered. Besides numerous flint artefacts and the accompanying fragmented stone tiles, the remains of *Equus ferus* fauna were also discovered.

The archaeological research to date makes it possible to interpret the findings as remnants of a long-term and multi-seasonal hunting camp. In the light of current knowledge the site in Klementowice is the north-easternmost exposure of the Magdalenian settlement in Europe which makes it in many ways exceptional. In 2012 detailed a geological and pedological survey was conducted in the Magdalenian site in Klementowice and its immediate vicinity (~1.2 ha). Soil sampling on a 10×10 m grid documented the occurrence of Luvisols both in the full profile (35.4% of the area), eroded (47%) and buried form (17.6%). This enabled the identification of the diversified development of the soil cover that currently has a strongly mosaic-like character documented on a gentle (~3–4°), uniformly inclined slope. The geostatistical analysis of full-profile soils enabled the reconstruction of the thickness of the denuded profiles. This, in turn, made it possible to reconstruct the primary land relief. GIS spatial analysis enabled the reconstruction of the originally undulating terrain from the end of the loess silt deposition period (Late Weichselian).

The inventory of soil profiles followed by the reconstruction of the primary relief provided the basis for analysing the distribution of archaeological artefacts relative to the contemporary and primary topographic surface. Based on the analysis, two groups of artefacts can be distinguished according to their location: the first are artefacts located in the present-day arable horizon; the second are artefacts occurring in the illuvial horizon. Primarily linked to soil erosion, the former artefacts occur in a secondary bed. Tillage lasting for at least several centuries led to the denudation of the soil cover and redeposition of archaeological artefacts. The second group – the buried artefacts – occur mainly in the illuvial horizon, particularly in its upper part identified as Bt1. Since they are located in naturally developed horizons, they are regarded as in situ artefacts.

Their location in the illuvial horizon proves the deposition of loess silt not only when the hunting camp existed but also in a later period. The loess layer overlying the archaeological artefacts (the sum of A and E soil horizons) is up to 50 cm thick, which proves the relative intensity of aeolian sedimentation processes. The clear concentration of artefacts in the relatively narrow zone of the site indicates a small role of redeposition processes taking place on the slope in a periglacial environment.

References

1. Wiśniewski T., Mroczek P., Rodzik J., Zagórski P., Wilczyński J., Nyvltova Fisakova M., 2012: On the periphery of the Magdalenian World. An open-air site in Klementowice (E Poland). Quaternary International, vol. 272–273, 308–321.

GEOARCHAEOLOGICAL INVESTIGATIONS ON SOIL MATERIAL FROM BRONZE AGE DITCHES IN SLOVAKIA

Schlütz F.[1], Nowaczinski E.[2], Bittmann F.[1]

[1]Lower Saxony Institute for Historical Coastal Research, Wilhelmshaven
[2]Geographical Institute of the University Heidelberg, Heidelberg

The Bronze Age Settlement Fidvár near Vráble (Slovakia) is situated close to the Slovakian Ore Mountains in the loess covered Danube hills. During the early Bronze Age it was successively inhabited by representatives of the Hatvan, Unjetice and Mad'arovce Culture [1]. During its greatest expansion in the Unjetice Culture, Fidvár was probably inhabited by about more than 1000 people. The settled areas were successively enclosed by three ditches of different diameter, reflecting the growth and later shrink of the population. The sediments of these ditches are here utilized as geoarchaeological on-site archives to reconstruct the former human-environmental relationship [2]. The sediments were AMS-dated and their sediment-logical, geochemical, archaeobotanical and palynological characteristics analysed, yielding an elaborated set of different physical, chemical and biological proxies. Although the processes of sediment accumulation including the enrichment of chemical elements like phosphorus and organic carbon as well as the deposition of pollen grains, spores, zoological remains, shard fragments, charcoal, charred cereal grains and seeds of weeds are not yet fully understood, first conclusions can be derived at the present state of investigations. While the ditch grounds were alternating between muddy and dry, the slopes were mostly dry and at least in some parts very rich in nutrients. Ramparts accompanying the ditches included constructions made of oak wood. The multi-proxy analyses of the upper core parts can help to understand the influence of the recent ploughing on the archives but furthermore reveal new information on valuable indicators for human activities in the past leading to a better understanding of the data from our on-going analyses of lake archives.

References

1. Bátora J., Behrens A., Gresky J., Ivanova M., Rassmann K., 2012. The Rise and Decline of the Early Bronze Age Settlement Fidvár near Vráble, Nitra. In: Kneisel J., Kirleis W., DalCorso M., Taylor N., Tiedtke V. (eds). Collapse or continuity?: Environment and development of Bronze Age human landscapes. Habelt, Bonn, pp. 111–129.
2. Nowaczinski E.; Schukraft G.; Hecht S.; Rassmann K.; Bubenzer O.; Eitel B. (2012): A Multimethodological Approach for the Investigation of Archaeological Ditches –Exemplified by the Early Bronze Age Settlement of Fidvár Near Vráble (Slovakia). Archaeological Prospection 19 (4), 281–295.

RAPID CLIMATE VARIABILITY DURING 64–18 KA BP: THE BLACK SEA VERSUS UPPER PALAEOLITHIC REGION KOSTENKI (RUSSIAN PLAIN)

Lyudmila S. Shumilovskikh[1] and Galina Levkovskaya[2]

[1] Georg-August-University of Göttingen, Germany, shumilovskikh@yahoo.com
[2] Institute of the History of Material Culture, Russia, ggstepanova@yandex.ru

The signature of Dansgaard-Oeshiger (DO) climate oscillations during the last glacial is well established in ice cores and ocean records. However, the effects of such global rapid climate changes in continental settings and their role in the transition process from the Middle to Upper Palaeolithic of the Europe remain challenging [1]. During the last years, the rapid global climatic fluctuations were reconstructed for Kostenki region [2], which is famous with very ancient Upper Palaeolithic sites [3], lasted from 50 to 12 ka BP (all ages presented in cal ka). The floodplain terrace, soil and deluvian sediments of the region were dated by tephra, geomagnetic method, IRSL/OSL and C^{14} dating. In order to provide regional land-sea correlations with special emphasis on environmental response to DO events, we present here the new pollen and dinoflagellate cyst (dinocyst) records from the Black Sea, known as a region that highly sensitive to Northern Hemisphere climate fluctuations [4]. The age-depth model of the investigated core 25-GC1, covering 64–25 ka BP, is based on tephra and geomagnetic methods and C^{14} dating [5].

The dominance of *Artemisia*, *Chenopodiaceae* and *Poaceae* in 25-GC1 reveals steppe vegetation in Northern Anatolia during the last glacial with a pronounced cooling trend towards 25 ka BP. Dinocyst records demonstrate brackish conditions in the Black Sea with pronounced freshening of the sea-surface towards 25 ka BP. The rapid climatic oscillations during the DO interstadials are clearly indicated by the spread of oaks and enhanced primary productivity in the sea, suggesting warmer and wetter conditions in the region during these warm phases. The Kostenki sequences show especially important role of extremely dry periglacial steppe climatic phase at ~42 ka BP and period of very unstable conditions between 42–40 ka BP. The both events separate two megastages: 1) elm, alder floodplain forests and wet meadows without coniferous forests (52–42 ka BP) and 2) spruce-pine forests and meadows, interrupted by cold phases with dominance of *Artemisia*, *Chenopodiaceae* and grasses and herbs (40–18 ka BP). The paleosoil sequences suggest a pronounced cryohydrophilious trend towards 25–20 ka BP. In this presentation we will provide new insights on palaeoclimatic conditions of Eastern Europe during the Paleolithic occupation of Kostenki.

References

1. Finlayson, C., 2008. On the importance of coastal areas in the survival of Neanderthal populations during the Late Pleistocene. Quaternary Science Reviews 27, 2246–2252.
2. Levkovskaya, G.M., Hoffecker, J.F., Anikovich, M.V., Forman, S.L., Holliday, V.T., Pospelova, G.A., Popov, V.V., Kartseva, L.A., Stegantseva, V.Y., San'ko, A.F., 2005. Klimatostratigrafiya drevneishih paleoliticheskikh sloev stoyanki Kostenki 12. In: Anikovich, M.V. (Ed.) Problema ranney pory verhnego paleolita Kostenkovsko-Borshchevskogo rayona I sopredel'nyh territoriy (in Russian), 93–130.
3. Anikovich, M.V., Sinitsyn, A.A., Hoffecker, J.F., Holliday, V.T., Popov, V.V., Lisitsyn, S.N., Forman, S.L., Levkovskaya, G.M., Pospelova, G.A., Kuz'mina, I.E., Burova, N.D., Goldberg, P., Macphail, R.I., Giaccio, B., Praslov, N.D., 2007. Early Upper Paleolithic in Eastern Europe and Implications for the Dispersal of Modern Humans. Science 315, 223–226.
4. Shumilovskikh, L.S., Tarasov, P., Arz, H., Fleitmann, D., Marret, F., Nowaczyk, N., Plessen, B., Schlütz, F., Behling, H., 2012. Vegetation and environmental dynamics in the southern Black Sea region since 18 kyr BP derived from the marine core 22-GC3. Palaeogeography, Palaeoclimatology, Palaeoecology 337–338, 177–193.
5. Nowaczyk, N.R., Arz, H.W., Frank, U., Kind, J., Plessen, B., 2012. Dynamics of the Laschamp geomagnetic excursion from the Black Sea sediments. Earth and Planetary Science Letters 351–352, 54–69.

PALEOENVIRONMENT, HUMAN OCCUPATION AND SEDIMENT PROVENANCE IN THE USUMACINTA RIVER, SOUTHERN MEXICO

Solís-Castillo B.[1], Solleiro-Rebolledo E.[2], Thiel C.[3], Sedov S.[2]

[1]Posgrado en Ciencias de la Tierra. Instituto de Geología, UNAM. 04510, México, D.F. bsolisc.geologia@gmail.com
[2]Instituto de Geología, UNAM. 04510, México, DF. solleiro@geologia.unam.mx; serg_sedov@yahoo.com
[3]Nordic Laboratory for Luminescence Dating, Department of Earth Sciences, Aarhus University, Risø, Frederiksborgvej 399, 4000 Roskilde, Denmark. chrth@dtu.dk

Paleosol sequences along the lowest terraces of the Usumacinta River in southern Mexico were used to reconstruct Holocene environmental changes, examine human–environmental interactions and changes in the Holocene alluvial landscape. Study sections were correlated through paleosol morphology, radiocarbon dating, and artifact seriation of Formative, Classic, and Postclassic ceramics. The alluvial sediments are dating by OSL. The oldest paleosols have gleyic features. Although they contain hard carbonate concretions dating to 5450–5380 cal. Yr B.P., these Gleysols formed in the Late Pleistocene, according to their OSL age (95,000 yr BP). During this period (Pleistocene) the river transported ultrastable heavy minerals from the highlands of Guatemala The uppermost paleosols lack gleyic features, the oldest of which contains vertic features, dating to 2000–2700 cal. Yr B.P., and contains abundant Formative period ceramics. The upper two paleosols are morphologically less developed and are strongly affected by human activities; radiocarbon ages and ceramic assemblages indicate that they belong to the Maya Classic and Postclassic periods. Stable carbon isotope values from the decalcified organic matter vary among paleosols of different ages and sites. $\delta^{13}C$ values are highest (−16 to −20 ‰) in the Formative period paleosol. Although it is possible that maize cultivation could contribute to the isotopic signatures, we believe that the $\delta^{13}C$ values indicate the dominance of drought-resistant C4 and CAM vegetation due to their association with vertic soils. The Classic period paleosol has a slightly lower isotopic value (−20 to −22 ‰), while the Postclassic paleosol shows the lowest values (−22 to −23 ‰), suggesting reforestation of the floodplain. These results indicate that the Early Holocene paleosols formed in a humid climate similar to that of today, which transitions toward dryer conditions around 5500 cal. Yr B.P. In the Late Holocene (approximately 3000 B.P.) an increase in seasonality occurs. The study composition minerals of Holocene paleosols evidence high amounts of volcanic minerlas, most of them fresh and with angular shapes, thus indicate a proximal source, probably from the Tacaná volcano.

LATE HOLOCENE PALEOSOLS WITH VERTIC FEATURES IN MEXICO: PALEOENVIONMENT AND LAND USE

Solleiro-Rebolledo E.[1], Solís-Castillo B.[2], Sánchez S.[2]

[1]Instituto de Geología, UNAM
[2]Posgrado en Ciencias de la Tierra, UNAM

Vertisols in modern landscapes of the world are easily recognized because of their clayey textures, dark colors, and special physical attributes. They are present in almost every climatic zones, however the largest occurrence of Vertisols is in areas with aridic moisture regime, with strong seasonal variations in precipitation and temperature. During several sessions of field work we have detected buried paleosols with vertic properties occupying Late Holocene landscapes of Mexico under quite different climate conditions. These paleosols occur in stable landforms associated to first humans settlements based on agriculture. In the Teotihuacan valley (central Mexico), in semi-arid environments, this palesol has named as Black San Pablo Paleosol (BSPP), which has been identified in both natural landscapes and under Teotihucan buildings. By the other hand, in the Maya area, in southern Mexico, under humid climates, Vertisols are related to Olmec archaeological remains. In both cases, Vertisols have dark A horizons and angular blocky structure, are very clayey and have Bk horizons. Organic matter from the A horizons in the two areas have similar ages (around 3000 yr. B.P.) while the carbonate accumulations are dated at 5500 yr. BP. Stable carbon isotope values from the decalcified organic matter has also similar values (−16 ‰). We suggest Vertisol presence in different environments of Mexico reflects the domain of semi-arid, seasonal climates. Perhaps their soil properties impose constraints on their use for agronomic practices, these paleosols are very productive if well managed. In consequence they can be considered as attractors for human settlement.

COMPARISON OF MIDDLE VALDAY INTERSTADIAL WEAK-DEVELOPED PALEOSOL AT THE SITES KHOTYLEVO I AND KOSTENKI 14

Voskresenskaya E.V.[1], Korkka M.A.[2], Otcherednoy A.K.[3]

[1]Institute of Geography RAS, Russia, kavosk@mail.ru
[2]Saint Petersburg State University, Russia, km31@yandex.ru
[3]Institute for the History of Material Culture RAS, Russia, mr_next@rambler.ru

Not much research has been dedicated to paleosols formed during the Middle Valdai (OIS 3) Interstadial in central part of East-European plane. There are even fewer studies on the spatial differentiation and component composition of the paleosols which have been preserved at sub-item positions in the river floodplain, aslope and in the flat-bottom valley rather than in the interstream areas. One of these key-site of studies of weak-developed paleosols of the second part of the Late Pleistocene is the famous Upper Paleolithic archaeological site Kostenki 14 (Voronezh Region). Five paleosol profiles have been highlighted here, four of which (K14/II-K14/V) had formed over the course of the Middle Valdai in a time interval from 28–38 C14 ka BP [1, 2]. In the work in question, we attempted to consider possible correlations of paleosol series from Kostenki 14 and Khotylevo I. In the process of the renewal of the studies, a series of three paleosols with Middle Palaeolithic industries was allocated at the site Khotylevo I (Bryansk Region) [3]. Based on properties of sedimentation of Late Pleistocene loess-soil series in this area and morphological features of soils we assume that the entire paleosol series formed within the Middle Valdai Megainterstadial. Going up the section, a directional trend towards of aridization and cooling of climate is reflected in the shift in types of soils. The profile of the upper paleosol is significantly perturbed by slope and cryoturbation processes. The two bottom paleosols highlighted from Khotylevo I section have retained clear marks of hydromorphis and have not been affected by cryogenesis during soil formation. Similar series of weak-developed soils, the lower paleosol unit of which had formed within the limits of floodplains and the upper paleosol unit of which are the slope versions of paleosol divergences, are also characteristic of the Kostenki 14 section. The paleosol unit K14/II marked as Bryanskaya by A.A. Velichko and S.N. Sedov [1, 2] has a morphologically similar structure to the first paleosol series of the Khotylevo I section. Paleosols K14/IV and K14/V are formed under hydromorphic conditions and are less perturbed by cryogenesis, as are the lower series of Khotylevo I. The age of the lower soil *series* studied at the Kostenki 14 is 28–37 Cal ka BP; radiocarbon data obtained from the second soil level of Khotylevo I are 42270±3300 (GIN-14414). And even though the cultural layers associated with paleosols appertain to Middle Palaeolithic (Khotylevo I) and Upper Palaeolithic (Kostenki 14) industries alike, we can still assume that they may have existed within the limits of the same chronological stage (OIS 3). Within the limits of the given interval, a similar directionality was observed in the formation of paleosols as a reflection of the complicated fluctuating dynamics climatic rhythm of the Middle Valdai Interval.

The studies were supported by RFBS project №11-06-00380-a

References

1. Velichko A.A., Pisareva V.V., Sedov S.N., Sinitsin A.A., Timireva S.N. Paleogeograpfia stoyanki Kostenki 14 (Markina Gora). Arkheologiya, etnograpfia i antropologia Evrazii. 2009 № 4 C. 35–50. (in Russian)
2. Sedov S.N., Khohlova O.S., Sinitsin A.A., Korkka M.A., Rusakov A.A., Ortega B., Solleiro E., Rozanova M.S., Kuznetsova A.M., Kazdym A.A. Pozdnepleistosenovye paleopochvennye serii kak instrument lokalnoy paleogeograpficheskoy rekonstruktsii (na primere razreza Kostenki 14). Pochvovedenie, 2010 № 8. C. 938–955. (in Russian)
3. Voskresenskaya E.V., Vishniackii L.B., Zuganova I.S., Novenko E.Yu., Ocherednoi A.K. 2011. New data on the evolution and age of sediments, enclosing the cultural horizon of the Middle Palaeolithic site Khotylevo I (Desna River basin). Materiali VII Vserossiiskogo soveschanija po izucheniju chetvertichnogo perioda, Vol. 1 (A–K), Apatiti, Saint-Petersburg, pp. 116–119. (in Russian)

SURFACE PALEOSOLS AND RELIC FEATURES IN MODERN PROFILES. CHERNOZEMS AS PALEO-ENVIRONMENTAL ARCHIVES

TRACING POLYMER NANOCOMPOSITES FORMED BY ANCIENT COSMIC AIRBURSTS IN CARBONACEOUS SURFACES FROM PALEOSOL ARCHIVES

Marie-Agnes Courty[1, 2]

[1]CNRS-UPR 8521 PROMES, Procédés et Matériaux Solaires, Rambla de la Thermodynamique, Tecnosud, 66100 Perpignan, France
[2]IPHES, Inst. Català de Paleoecologia Humana i Evolució Social, Univ. Rovira i Virgil, Tarragona, Spain, marie-agnes.courty@promes.cnrs.fr.

The 15 February 2013 violent airburst over Chelyabinsk Oblast (Ural, Russia) caused by the high altitude disintegration of a small asteroid has boosted a popular interest for this range of natural hazards. These recurrent explosive events have been for long known to represent a serious threat to human populations, land properties and ecosystems. The ongoing controversies on their hypothetical signatures traced in all kinds of terrestrial archives shows a surprising reserve of most scientific communities that should be deeply concerned by these exceptional geogenic events. We intend here to question the contribution of the singular organic/inorganic materials that cosmic airbursts appear to produce in the wake of hypervelocity colliders by physico-chemical transformation of atmospheric aerosols on the long term sequestration of soil carbon.

We describe how we have meticulously collected these materials from nearly intact soil surfaces that recorded recent airbursts (2011, 2008, 1908 Tunguska, 1864 Orgueil meteorite). We explain their synthesis by comparison with similar materials formed by hypervelocity experiments with the light-gas gun apparatus.

We illustrate how we have identified similar soil surfaces with the pulverized singular organic/inorganic materials in Quaternary and pre-Quaternary archives. The selected examples concern a late Holocene soil surface across the Darwin crater region (Tasmania), a middle Holocene one from loessic sequence in north-eastern Syria, a Younger Dryas one from aeolian sand dunes in the Arcachon basin (south-west France), a middle Pleistocene one from colluviated pedo-sediments at Bose region (south China) and one at the K/T boundary from colluviated pedo-sediments in northern Spain. The analytical data integrate an in situ characterization at meso to nano scales of mineral, metal and carbonaceous phases using Environmental SEM with EDS, Raman, micro-spectrometry, XRD, AFM, TEM, Tof-SIMS, nano-indentation, elemental and isotope analyses.

We present the three major types of polymer nanocomposites that are common to all the situations encountered: refractory hard, elastic glassy carbon with well crystallized graphite; hard, plastic polymer formed of well crystallized paraffine; and amorphous soft, plastic polymer. They display similar structural, chemical, thermal and mechanical properties, and carbon isotope signatures that indicate formation from terrestrial precursors. We discuss how this range to of singular characteristics provides solid criteria to trace the occurrence of the polymer nanocomposites in natural paleosols and in anthropogenic ones of ancient habitats. We show that great concentration of polymer nanocomposites correlate with dark brown micro-stratified facies in paleosols sequences. We illustrate their distinctive spatial pattern in the microfacies that are relict of natural carbonaceous surfaces formed by airblasts from the ones that are firing microfacies of human origin. We explain for the later why the assemblage of polymer nanocomposites indicates intentional collect by ancient humans for preparing combustible, adhesive, colouring materials. In conclusion, we question why scientific communities appear to have ignored for so long a unique type of carbon of major importance for ancient humans. Its remarkable long term durability upon exposure to multiple environments raises major implications on its critical role on physical soil properties.

PHAEOZEM SOIL RELICT PROFILE OF INTRAZONAL LANDSCAPE OF KAZAKHSTAN SEMIARID ZONE

Gavrilov D.A.[1], Golyeva A.A.[2]

[1]Institute of Soil Science and Agrochemistry of SB RAS, Russia, denis_gavrilov@list.ru
[2]Institute of Geography of RAN, Russia, golyevaaa@yandex.ru

In the intersugarloaf downlands of Kazakh Hills in the deserted steppes a special type of Phaeozems Sodic (WBR) occurs on the heavy loam eluvium-deluvium deposits under additional ground moisture. Morphological structure of Phaeozems Sodic is distinguished with untypical large thickness of humic horizon (60–65 cm).

The purpose of our study was to reveal profile forming stages of that type of Phaeozem (Ulytau distirict, Karaganda region, Kazakhstan).

While studying soil profile there was revealed heterogeneity of humus horizon structure: AJ (0–20 cm) – recent humus horizon, $[AU\text{-}B]_{dl}$ (20–30 см) – humic diluvium (from dark grey to brown) which was actively converted by the soil forming process and [AU] (30–60 см) – dark grey buried humic horizon.

Analysis of phytholite profile has shown that humic horizon was formed under steppe conditions with natural decomposition of arid and meadow grasses reflecting climatic fluctuations. In the lower part of humic horizon there are paleocrotovines that mark automorphic conditions of buried humic horizon functioning in the period of its exposing. Burnt phytholites and inclusions of stone tools attributed to primitive man let us conclude that the soil profile was formed under anthropogenic affect. According to radiocarbon dating we can say that humic horizon was formed in AT-2 (6215±170–6500±135 B.C.). Humus layer on depth 20–30 cm was formed later (6415±175 (SOAN-8842)) than that on depth 40–50 cm (6215±170 (SOAN-8843)). The date inversion, transaccumulative position of soil and its heterogenic color ([AU-B]) let us state that humus layer (20–30 cm) is a relict of Middle Holocene humic horizon which was moved from a hypsometrically higher point (sugarloaf slope).

As the results of Phaeozems Sodic soil profile study there are distinguished three main stages of profile forming:

I. In AT-2 characterized with favorable climatic conditions, under the cover of steppe (meadow) grasses there was formed Chernozem soil. In its profile there were found reed phytolites and burnt wood detritus marking human presence;

II. At the end of AT-2 and the beginning of SB periods the environment changed sharply in the direction of climate aridization having led to erosion that caused diluvium forming over Atlantic humic horizon;

III. At that period a new humus forming stage took place with simultaneous dying of humic diluvium lasting to present time.

Thus, Phaeozems soil complex (relict) profile forming is the result of eluvial and synlithogenic pedogenesis in steppe conditions during nearly 7000 years.

CHERNOZEMS IN EUROPEAN RUSSIA: CENTRAL IMAGE, PEDOGENESIS, PROBLEMS

Maria Gerasimova, Nikolay Khitrov, Alexander Makeev

Moscow Lomonosov University, Dokuchaev Soil Institute

Chernozems were among the first objects of soil research in Russia, and they were studied by many pedologists during more than a century. Several theories of their origin were proposed, as well as their central images; however, many pedogenetic aspects remain disputable. One of the most fascinating features of chernozems is a thick homogeneous humus layer sometimes exceeding 130 cm. There are attempts to explain this phenomenon by the reasons other then bioclimatic impact (e.g. Neogene cultivation, steppe fires or combination of both). It is now well documented that Chernozems first appeared in the Late Miocene (more then 7 Ma) as a result of grass ecosystem evolution (co-evolution of grasses – grazers – Mollisols) [1]. Chernozems developed for several thousand years, most probably through the whole Holocene basically being in equilibrium with the environmental conditions until now.

The central image of Russian chernozem presumes the combination of the dark-humus (AU) and carbonate-accumulative (BCA) horizons formed in loess. The former is rich in humus of humate nature, has intricate pedality and perfect structure, which is mostly due to the activity of earthworms [2]. The microstructure is crumb in the upper part of AU horizon and spongy in the lower one; density is close to 1 g/cm^3. The earthworms and the burrowing mammals modify the horizons' boundaries, effervescence depth, pathways of solution flows, and perform the exchange of material between the major horizons (AU↔BCA), which contributes to the profile stability and increases the humus profile depth. The loess fabric (high porosity and vertical planar voids) is favourable for bioturbation and formation of a thick humus layer.

Morphological forms of secondary carbonates in BCA horizon are correlated with the current pedoclimate, they serve as criteria to differentiate among chernozems, and may be grouped into: (i) labile forms, (ii) segregations, (iii) hard nodules and pans; the latter group is inherent to soils affected by ground water and is beyond the scope of the central image. Typical Kursk chernozem mostly has labile carbonates, therefore, is referred to migrational-mycellary one. Secondary carbonates comprise: pseudomycelium and impregnation mottles at 'macro' level; needle-shaped crystals in voids, (quasi)coatings, mould-like bloom mostly on coprolites at 'meso' level; lublinite intergrowth in voids, micritic coatings with sparite grains at 'micro' level. The labile forms of carbonates are in agreement with the data on current soil regimes: the coincidence of periods with high moisture, low temperatures, and high concentration of CO_2 at the AU–BCA interface [3], where living roots still occur and pedofauna is active.

The age of humus in AU horizon of Russian chernozems according to radiocarbon dating varies from 1 kA in the top part to 5–8 kA in the lower one [4]; the non-calibrated age of humus in the Kursk profile, it is 1.4 and 5.6 kA, respectively. The increase of the age with the depth was defined by M. Glazovskaya [5] as synpedogenic fossilization of the most stable humus fractions. The share of fossilized carbon in chernozems reaches ¼ of its total pool.

Both diagnostic horizons of Kursk chernozem do not fully coincide with the respective mollic and calcic horizons in WRB [6]. The criteria for mollic are too broad, the requirements for carbonates in calcic are too high; hence, part of chernozems may be qualified for Phaeozems.

References

1. Retallack G.V. 2001. Soils of the Past: an Introduction to Paleopedology. 2 ed. Oxford. 600 pp.
2. Chernozems of the USSR. 1974. Vol. 1. Kolos Publ. 64–281.
3. Afanas'eva E.A. 1966. Chernozems of the Middle-Russian Upland. Moscow: Nauka Publ. 223 pp.
4. Chichagova O.A. 1985. Radiocarbon Dating of Soil Humus. Moscow: Nauka Publ. 157 pp.
5. Glazovskaya M.A. 2009. Pedolithogensis and Continental Cycles of Carbon. Moscow, URSS Publ. 330 pp.
6. IUSS Working Group WRB. World Reference Base for Soil Resources, 2006. World Soil Resources Reports No. 103. FAO, Rome. 128 pp.

EVOLUTION OF CHERNOZEMS IN THE SOUTHERN FOREST-STEPPE OF THE CENTRAL RUSSIAN UPLAND UNDER THE ANTHROPOGENIC INFLUENCE

Khokhlova O.S.[1], Chendev Yu.G.[2]

[1]Institute of Physicochemical and Biological Problems of Soil Science, Russian Academy of Sciences, Pushchino, Russia, akhokhlov@mail.ru
[2]Belgorod State University, Belgorod, Russia, sciences@mail.ru

Chernozems are the major component of soil cover in forest-steppe of the Central Russian Upland, and the Gray Forest soils take the second place by the square in this zone. The problem of mutual transitions of these two soil types to each other have been discussed for more than 100 years. According to Taliev (1902), a deforestation and an increase the area of arable and meadow lands were the cause of a spread of steppe vegetation far to the north; and the soil types transformation from Gray Forest soils to Chernozems is a result of a steppe appearance instead of forest during the last centuries. Based on the annalistic sources, Pavlenko (1955) points to a significant density with absence of grass cover of primeval deciduous forests that existed 300–400 years ago in typical forest steppe, i.e. before a considerable colonization of this territory. Historical and cartographic analysis of human-induced land cover changes in Nizhny Novgorod province showed the localization of the Podzolic Chernozem areas to the territories which were deforested more than 200 years ago (Fatyanov, 1959). A number of other authors do not agree with the above conclusions. The aim of this work was to study the evolution of Chernozems in the southern forest-steppe of the Central Russian upland under the anthropogenic influence.

In different parts of Belgorod region we studied five agrochronosequences including the Gray Forest soils under the native broad-leaved forest and closely located agrogenic lands with 100, 150, 220 and more years of duration of plowing within the watershed key plots. The key plots search was done based on archival maps. In Voronezh region, on the fields of the Voronezh Experimental Station of the Maize Institute, the agrosequence was also studied. It included the Dark Gray Forest soil under the oak and linden forest situated close to fields of the Station and three agrosoils on which the field experiment with different types of agrogenic practices (monoculture of maize, bare fallow and crop rotation) is carried out during last 50 years. According with the archival data, the cultivation on the Station began 250–300 years ago. And in present, the soils of the Station are classified as Agro-Chernozems.

Our data supported the hypothesis of the convergence of properties of the Gray Forest soils with Chernozems under the influence of cultivation. The agrogenic use resulted in a greater thickness of the humus profiles, an increase in the number of krotovinas, the lowering of the textural differentiation coefficient (calculated by the clay content), an increase in the concentration of nutrients in the 1m thickness, and the alkalization and carbonization of the former Gray Forest soils. The result of processes of humus accumulation and flattening of the curve of humus distribution down profile because of organic carbon accumulation in 20–80(100) cm layer of the former Gray Forest soils are observed after 200 years of cultivation. As well, the loosening of the subsurface layer till the 80(100) cm and decreasing of soil density in this layer were revealed in the arable lands with more than 200 years duration of cultivation. The uplifting of carbonates and their accumulation in the second meter of profile of agrosoils occurred for less than 50 years of their using in agriculture.

This work is supported by RFBR, N12-05-97512-r-tsentr

References

1. Pavlenko I.A. Lesostepnyye pochvy nagornykh dubrav pravoberezhya reki Vorskly i ikh proiskhozhdeniye // Materialy po geografii i genezisu pochv lesnoy zony Yevropeyskoy territorii SSSR. M: Izd-vo AN SSSR, 1955. 191–287.
2. Taliev V.I. Chelovek kak botaniko – geograficheskiy faktor // Nauchnoye obozreniye. 1902. № 11:42–61.
3. Fatyanov A.S. Opyt analiza istoriirazvitiya pochvennogo pokrova Gorkovskoy oblasti // Pochvenno – geograficheskiye issledovaniya i ispolzovaniye aerofotosyemki v kartografii pochv. M: Izd-vo AN SSSR, 1959. 3–171. (In Russian)

VARIABILITY OF CARBONATE PEDOFEATURES (CP) IN SOILS OF ALEXANDROV QUARRY[‣]

Irina Kovda

Institute of Geography, Russian Academy of Sciences, Moscow

A number of pedogenic carbonates representing various morphologies (veins, pseudomicelium, impregnations, soft masses, hard concretions) were investigated along the vertical sequence of Pleistocene paleosols below the modern Chernozem in the Alexandrov quarry. The quarry is situated in Kursk region in the centre of the European part of Russia. The present day environment is represented by moderate continental climate with MAT 5.5 °C and MAP 580 mm yr^{-1}, grassland, flat geomorphology at a place of former gully. Soils including paleosols are formed on a loess-like parent material, sometimes mixed with re-deposited eroded soils from the surrounding watersheds. CP were studied morphologically in the field, with further laboratory investigation using stable isotope method, scanning electron microscopy and micromorphology. ^{14}C-dates were obtained for selected specimens. This research was aimed to better understand the formation and distribution of CP in modern Chernozem and paleosols of Alexandrov quarry, and their use for paleoreconstructions.

Modern soil is almost completely leached except for the labile forms at a depth below ~90 cm. Small and rare concretions occur below 170 cm depth. The lower loess-paleosols thickness is intersected by vertical fissures filled with carbonates, and carbonate coatings along vertical megastructural surfaces. Two-three subhorizontal layers of CP were found related to Bryansk, Aleksandrov and Strelestk paleosols, and loessial deposits above Ryshkov paleosol. Soft and hard CP fill the vertical cracks. Hard concretions are of variable form including flat plate-shape concretions in the bottom part. The ^{14}C-age of the carbonates (~3–7 kyrs BP) is much younger that the age of the organic matter of the corresponding paleosols (33 to >49 kyrs BP) at the same depth. ^{14}C-age of the concretion from modern Chernozem is 3680±90 BP.

CP from each paleosol are to some degree grouped according to their isotopic compositions, and their $\delta^{13}C$ is heavier than in modern Chernozem, while $\delta^{18}O$ of modern soil has the intermediate value. The stable isotopic compositions of C and O measured along the vertical clusters of CP in the cracks suppose that all these features were formed much later and do not reflect the environment during the paleopedogenesis.

Original and secondary CP were identified according to their morphology and distribution in the paleosols. High variability of CP on macro-, micro- and submicroscopic levels, as well as clear shift in their stable isotopic compositions indicate several generations and multiphase formation of carbonates. The upper 3 to 4 meters have the evidence to be involved in the circulation of water and processes of carbonate dissolution and re-precipitation in present time and in the past, which resulted in the formation of large vertical coatings, platy vertical concretions and vertical clusters of concretions. They are often post-pedogenic. Features related to the past cryogenic processes were identified on macro-, micro- and submicroscopic levels in paleosols. Rounded concretions from Chernozem, and upper paleosols seems to be of the same one generation. CP including hard concretions are leaching in the modern wet environment in the top, re-distribute and re-precipitate with continuing growth in the upper paleosols, which resulted in similar ^{14}C-dates but larger size of concretions from Bryansk paleosoil.

[‣]This research was supported by the Presidium of Russian Academy of Sciences, Program No 13.

RECENT AND RELIC PEDOFEATURES IN ARIDIC SOILS OF CENTRAL ASIA

Lebedeva (Verba) Marina[1], Shishkov Vasilii[2]

[1]V.V. Dokuchaev Soil Science Institute, Moscow, Russia, m_verba@mail.ru
[2]Institute of Geography, Russian Academy of Sciences, Moscow, Russia

INTRODUCTION. It is known that the system of methods to study the soil evolution as based upon comparing the profiles involves the method of genetic (factorial) rows including climatic ones. The genetic analysis of different levels in the soil profile organization and the present-day instrumental methods in particular helps enlarging the information about soil evolution. Micro- and submicroscopic methods allow dividing the soil neoformations into lithogenic and soil ones, the latter being subdivided in recent and relic pedofeatures.

OBJECTS OF RESEARCH. Under study were automorphic soils in the Subboreal zone of Central Asia (from southern Russia to Uzbekistan, Kazakhstan, and Mongolia) – Gypsic Calcisol, Yermic-Gypsic Calcisol, Yermic Regosol, and Yermic-Gypsic Regosol. All the studied soils are developed from clay loamy sediments of different genesis (slightly saline proluvial Quaternary deposits and Cretaceous-Paleogene rocks). Thin sections were prepared from soil samples taken in genetic horizons of aridic soils in the row of increasing climate aridity. The studied soils revealed the identical morphology of soil horizons – the crust, subcrust and middle horizons. The more aridic soil surface is always covered by of pit gravel.

INVESTIGATION METHODS. The polarizing microscope Olympus, raster electronic microscope JEOL jsm-6060A with conjugated system of X-ray microanalysis EX-2300BU were employed to specify the diagnostics the fabric elements of desert soils.

RESULTS. Micromorphological investigations of the studied soils showed a great diversity of microfeatures inherent to gypsiferous, carbonate and textural pedofeatures in horizons of aridic soils. Their peculiarities involve a combination of different-aged pedogenic and lithogenic pedofeatures connected with the initial salinity of ancient deposits and the stages of soil evolution. Relic gypsiferous pedofeatures with dissolution traces and carbonate pedofeatures (large gypsiferous pendents, carbonate concretions, compound layered silica-iron-carbonate nodules) serve as avidence of humid stages in the pedogenesis or lithogenesis described for arid areas in scientific literature. In the course of the recent pedogenesis a complex of pedofeatures is developed which are different in genesis due to (1) dissolution of gypsum and salt patches (the formation of different-shaped leaching voids), (2) exchange reaction between salt-enriched sulfate-sodium soil solutions and the calcite of the soil mass (the formation of star-shaped and star-shaped-salt microforms of gypsum), (3) local leaching of relic gypsum forms followed by the formation of dissolution cavities and recrystalline gypsum forms under detritus), (4) carbonate-calcium migration throughout the soil profile with the formation of micritic coatings on detritus, large mineral fractions or walls of the most great voids-fissures. In middle horizons of different aridic soil types there are textural pedofeatures in the kind of clayey coatings and papulas, thus indicating the stages of humid pedogenesis in the evolution of arid areas. The climate aridisation had no effects on microfeatures of the previous humid stages of intensive clay migration. The manifestation degree of textural pedofeatures depends on (1) the initial content of clay particles in the parent material, (2) the intensity of relic solonetzic complex and (3) the carbonate enrichment degree of clayey coatings during the climate aridisation. The aridic soils taken as objects of further investigations are promissing to be determined by a great diversity of soil microfeatures, the presence of specific microhorizons in aridic soils, the abundance of microforms of salt pedofeatures and a better maintenance of relic pedogenic features in the microfabric under conditions of the present-day low bioclimatic potential.

This study was supported by the Russian Foundation for Basic Research, project no. 12-04-00990.

ZONAL SOIL PATTERN IN RELATION TO GLACIAL HISTORY OF THE RUSSIAN PLAIN

Makeev Alexander, Yakusheva Tatyana

Moscow State University, Moscow, Russia

Since Dokuchaev Russian plain is known as a classic model of bioclimatic zonal soil sequence. However, soil geographic pattern correlates also to glacial history where earlier glaciations were more extensive than most recent one. The pattern of glacial and periglacial sediments and corresponding paleocryogenic and relic soil features follow three conspicuous belts.

1. Extensive loess mantles characterize the area south of Moscow (Late Saalian) glacial limits. Polygenetic features in Faeozems and Chernozems are determined by loess stratification, marked by paleocryogenesis, paleohydromorphism and relic soil features. These features are mostly pronounced in the soils of high interfluves (Opolie). Periglacial environment resulted in a network of thermokarst depressions. Constitution of loess strata depends on its position in a paleocryogenic complex. A clear evidence of sequential loess sedimentation, accompanied by slope processes and pedogenesis is presented in soil profiles within depressions. Sequential sedimentation here is confirmed by cryomorphic features (ice wedges, frost cracks, pseudomorphs) at different levels of loess strata. Slope processes resulted in micro striping of loess sediments. Buried humus horizons here are present at different depth.
2. An area within Moscow (Late Saalian) glacial limits is characterized by a diverse set of sediments (separate bodies of loess, glacial till, fluvioglacial sand, etc.) as a result of complex glacio-dynamic structure of cover glacier and high dissection of relief. The key to understanding relic soil features is the fact that day surfaces on different types of relief are heterochronous. Surface sediments of glacial and periglacial origin here exhibit clear vertical zonality. On the highest positions (200–250 m a.s.l.), thick cover (3 to 5 m) of mantle loams (northern variety of loess) overlay glacial till. In the intermediate positions (170–200 m a.s.l.), only a thin veneer of sand, sandy loam, sometimes loess, covers glacial till. Fluvioglacial and fluvial sediments cover the surfaces below 170 m. The sediments in the intermediate position (glacial till) were subjected to pedogenesis since Late Saalian time till now. Such surfaces cover extensive terrain within Late Saalian limits (State Soil Map of the Soviet Union, 1:1 000 000). Soil profiles include two-layered sedimentary sequence: sandy loam or sandy clay loam covered by 30–70 cm of sand or sandy loam (glacial cover beds). Upper horizons have been formed in the cover bed and lower – in glacial till. So the E/Bt horizonation of Glossisols and Luvisols on glacial till is largely inherited from stratified sediments. An initial lithological discontinuity within the profile of surface soils provides an opportunity to assess the depth and cumulative effect of pedogenesis since Late Saalian time.
3. Within Valdai (Weichselian) glacial limits high flooding prevented extensive loess accumulation. Soils inherited specific layering of sediments (laminated clays, fluvioglacial sands and glacial till with veneer of fluvial sand; on higher levels glacial till with thin veneer of cover sand, sometimes of loess).

Relic soil features need to be further investigated in relation to glacial history. On glacial and periglacial plains, they allow re-evaluating not only soil genetic models but also zonal soil pattern, with bioclimatic grade superimposed on zonal sequence of sediments and zonal pattern of paleocryogenic features.

THE INHERITED PEDOGENESIS SIGNS IN THE UPLAND SOILS OF TUNDRA AND FOREST-TUNDRA

G.V. Rusanova, O.V. Shakhtarova, S.V. Deneva, E.M. Lapteva

Institute of biology, Komi Science Centre, The Urals Branch, Russian Academy of Sciences, Syktyvkar, Russia, olga.shakhtarova@mail.ru

The environmental reconstruction based on the soil memory, inherited soil signs is still one of the most important issues in soil science [1].

Northen forest-tundra and southern tundra upland soils (cryomethamorphic soils, Fe-Illuvial svetlozems, cryomethamorphic gleezems) are formed on silty clay-loamy deposits in tundra landscapes ecosystems and forest patches in forest-tundra have been studied.

The complex approach was used, which includes analysis of both structural organization and differentiation of functioning products; revealing cryogenic and pedogenic processes; lithochemical method of determining of maturity and weathering degree; analysis of humic pedorelicts.

Formation of top soil profile is effected both by recent cryogenesis (specific cryogenic organization, structure formation) and pedogenic processes of tundra stage of pedogenesis (gleyzation and Al-Fe-humic differentiation and profile migration of mobile organic acids are diagnosed by analysis of cutan complex).

According to results of indicational-geochemical analysis the underlying horizons preserving inherited signs from past stages (fragments of clay cutans, buried humus horizons) represent higher maturity and weathering degree. Inner aggregate mass, which conserves its properties under cover of sandy-silty cutans, represent the eluvial-illuvial pattern of profile differentiation to be inherited from taiga pedogenesis stages.

Concretions are still the memory source of soil evolution stages and soil formation during long period. Concretions are quite stable by the form, composition, quantity and color under stability of soil hydrothermal regime. Long-term human impact results both in change of content and fraction compositions of concretions, abrasion of the signs remained from the former pedogenesis stage. Generation, which analogous to the new hydrothermal regime according to their features, to be formed.

Study of evolutional-genetic soil features, structural organization and differentiation products of functioning, lithomatrix reformation intensity, humic pedorelicts, concretions reveales the combination of recent and inherited signs related to changes of bioclimatic factors during the Holocene and under human impact. The revealed information can be used for long-term forecast of tundra ecosystems evolution under global climate change.

The study is supported by Program of UB RAS, project No 12-T-4-1006 “Ecological quality of reference soils in the European North-East of Russia and soil bioorganic potential as a criterion of soil productivity and protection in the background of the being prepared Soil Red List for the Komi Republic”.

Reference

1. Targulyan V.O. red. Pamyat pochv: Pochva kak pamyat biosferno-geosferno-antropogennyh vzaimodeistviy. M.: Izd-vo LKI, 2008. 692 s. (in Russian)

PEDOGENESIS OF CHERNOZEMS IN CENTRAL EUROPE

Vyslouzilova Barbora[1, 2], Schwartz Dominique[1], Sefrna Ludek[2], Ertlen Damien[1], Dreslerova Dagmar[3]

[1]Laboratoire Image, Ville, Environnement. Faculté de Géographie et D'Aménagement ERL 7230. UDS/ CNRS, 3, Rue de l'Argonne, 67083 Strasbourg, barbora.vyslouzilova@live-cnrs.unistra.fr

[2]Department of Physical Geography and Geoecology, Faculty of Sciences, Charles University in Prague, Albertov 6, 12843 Praha 2, Czech Republic

[3]Institute of Archaeology, Czech Academy of Science, Letenska 4, 11801, Praha 1, Czech Republic

Chernozem is characterized by a deep, dark surface horizon, rich on organic matter tending to change into a carbonate, mostly loess subsoil. By definition chernozem is a zonal soil, which was developed under tall-grass vegetation within dry continental climate. Large chernozem areas are situated in the steppe zone of Eastern Europe, Asia and North America. Nevertheless chernozems are also present in Central Europe, where the climate is not favorable to their existence. This fact is to be studied in order to understand the paleoenvironmental conditions which lead to the evolution of this soil type.

In Central Europe defined climate and environmental conditions of pedogenesis of chernozems were dominant only in Early Holocene. The presence of chernozems in the region is mostly explained as residues of Boreal steppes which were preserved up today thanks to agriculture: the open landscape covered by culture of cereals is supposed to simulate the steppe condition [1], especially by enrichment of soil by organic material of roots' origin. This idea is in conflict with paleo-botanical evidence of Holocene and pedological studies. In addition there are some sites in the Central Europe where we do find chernozem under forest [2, 3, 4]. These discrepancies lead to look for other factors of the pedogenesis of chernozems [5].

The goal of this study is to analyze the biogeographical conditions of pedogenesis of Central European chernozems. The main tool used for this study is qualitative analysis in near-infrared spectroscopy (NIRS) of soil organic matter to identify the type of vegetation in the origin of these components, the method proposed by Ertlen et al. [6]. For this purpose, a database of a representative population of chernozem and paleochernozem has been established. These sites have been described mainly in the Czech Republic but also in Hungary, Slovakia and France. This reference database also includes never cultivated chernozems, which are very rare in today's landscape.

Besides ^{14}C measurements are performed to determine the mean residence time of soil organic material. The charcoal preserved in soil extracts and identified and dated. The set of methods is coupled with analysis of, pollen and mollusks from the literature.

References

1. Lozek, V. 1973. Priroda ve ctvrtohorach. Academia, Praha, 373 p.
2. SCHKO Palava 2006. Rozbory CHKO Palava. Mikulov, 128 s.
3. Surina et al. 1999. Atlas pod SR. Bratislava. 60 s.
4. Franz, H. 1955. Zur Kenntnis der Steppenböden im pannonischen Klimagebiet Österreichs. Die Bodenkultur 8, p. 125–132.
5. Eckmeier et al. 2007. Pedogenesis of chernozems in Central Europe – A review. Geoderma 139, p. 288–299.
6. Ertlen, D. et al. 2010. Discriminating between organic matter in soil from grass and forest by near infrared spectroscopy. Eur. J. Soil Sci., 61, p. 207–216.

PRE-QUATERNARY PALEOSOLS: PALEOECOLOGY AND POST-BURIAL CHANGES

PALEOENVIRONMENTAL SIGNIFICANCE OF CARBONIFEROUS PALEOSOLS OF THE EAST EUROPEAN PLATFORM

Alekseev A.O.[1], Alekseeva T.V.[1], Kabanov P.B.[2]

[1]Institute of Physical, Chemical, and Biological Problems of Soil Science, Russian Academy of Sciences,Pushchino, Russia, alekseev@issp.serpukhov.su, alekseeva@issp.serpukhov.su

[2]Geological Survey of Canada, Calgary, kabanovp@gmail.com

Carboniferous of the Moscow Basin is one of the brightest examples of carbonate sedimentary systems with numerous subaerial exposure horizons marked by paleokarsts and paleosols, which endeavour landscape reconstruction including types of soils and associated terrestrial sediments, general features of vegetation, and temporal changes of paleoclimates [1]. This work is the detailed and interdisciplinary record of the recently discovered Carboniferous paleosols in southernMoscow basin of (~25 profiles of Mississippian and Pennsylvanian paleosols). In the soil cover of the territory of Moscow sedimentary basin during the late Mississippian hydromorphic soils prevailed: histosols, gleysol. The principal clay mineral in these soils is smectite (low charge montmorillonite). Organic matter preserved in the form of coal; aromatic structural components dominate. All profiles are calcimagnesian systems containing micritic calcite and are characterized by the common properties. Carbonate (35–78%) – is calcite with $\delta^{13}C$ (−2.3 ‰) – (−7.1 ‰) of bulk samples and $\delta^{13}C$ (−5.9 ‰) – (−10.7 ‰) of micrite. The main clay mineral is authigenic Mg – rich trioctahedralsmectite – saponite. Authigenicsaponite is developed in alkaline media with large MgO (min. 6%) and small Si and Al concentrations. Such conditions correspond to shallow marine or salted continental basins of arid/semi-arid climates with prevailing of evaporate conditions. We interpret the studied beds as extremely shallow-water lacustrine deposits transformed by repeated subaerial emersion episodes into palustrinepedosediments. While the Late Mississippian paleosols are smectitic, in Pennsylvanian paleosols palygorskite (sometimes sepiolite) became the principal mineral testifying the aridity of Late Carboniferous climate on the territory of Moscovian sedimentary basin. A detailed study of a representative Podolskian-paleo-pedon reveals development of soil carbonate ($\delta^{13}C$ (−4.6 ‰)), low alumina/bases and Ba/Sr ratios, enhanced Mn and Sr, presence of soil gypsum, and a characteristic peak in magnetic susceptibility, all suggesting a semiarid to arid pedogenic environment. Starting from Veneviansubstage with the gradual aridization of climate increased the global role of Mg in mineral formation: saponite, palygorskite, sepiolite. Most of studied paleosols contains inborn OM, detectable by chemical methods and ^{13}C NMR – spectroscopy. Organic carbon content and composition depends on the mechanisms of OM protection against diagenetic transformations, which are determined by the mineralogical composition and interactions between mineral matrix and organic molecules.Found palygorskite–humic substances derivate seems to be the earliest (~300 Ma)evidence for Pennsylvanian(semi) arid humification [2].

References

1. Kabanov P.B., Alekseeva T.V., Alekseeva V.A., Alekseev A.O., Gubin S.V. Paleosols in late moscovian (Carboniferous) marine carbonates of the East European craton revealing "great calcimagnesian plain" paleolandscapes. Journal of Sedimentary Research, 2010, V. 80, P. 195–215.
2. Alekseeva T.V., Kabanov P.B., Zolotareva B.N., Alekseev A.O., Alekseeva V.A., Humic Substances of the Late Carboniferous PalygorskiticPaleosol from the Southern Moscow Region, Russia / 2009 Doklady Biological Sciences, V. 425, P. 128–132

DEVONIAN PALEOSOLS OF VORONEZH ANTECLISE: GEOCHEMISTRY, MINERALOGY, PALEOENVIRONMENTS

T. Alekseeva[1], P. Kabanov[2], A. Alekseev[1], S. Gubin[1], S. Naugolnykh[3], V. Alekseeva[4]

[1]Institute of Physical, Chemical, and Biological Problems of Soil Science, Russian Academy of Sciences, Pushchino, Russia, alekseeva@issp.serpukhov.su
[2]Geological Survey of Canada , Calgary, Pavel.Kabanov@NRCan-RNCan.gc.ca
[3]Geological Institute, Russian Academy of Sciences, Moscow, Russia, naugolnykh@rambler.ru
[4]Moscow state University, geography department, Moscow, Russia, valekseeva@rambler.ru

Devonian (Givetian- Frasnian) age complex of 4 paleosols was discovered by our team in 2010 in Voronezh region (European Russia). Devonian deposits of Central Russia on the northern slope of the Voronezh Anteclise are known as Central Devonian Field [1]. These deposits, especially Yastrebovskaya age suite are famous due to the very rich and unique complex of terrestrial Devonian flora [2]. Discovered paleosols (PS) are developed from terrigenous material: argillites of Ardatovskaya age suite in the bottom (PS1) and tuff – sandstones of Yastrebovskaya age suite in its middle part and in the top (PS2-PS4). The whole thickness of the complex is about 6 m. All 4 paleosols are characterized by good profiles preservation; one of them (PS3) – by the unique preservation due to its fast burying under the thick (1 m) layer of dense argillite. It provided the preservation of the top organic – rich horizon and *in situ* large-scale rooting systems which, most probably, belong to progymnosperms. All paleosol profiles demonstrate several similar characteristics : *in-situ* roots, elluvial – illuvial clay re-distribution; kaolinitic mineralogy; presence of carbonate (siderite) nodules (2.5Y 4/4); the enhance values of MnO/Al_2O_3 (intensity of pedogeneisis) and Fe_2O_3+MnO/Al_2O_3 (degree of oxidation); existence of red hematite-rich horizon in the bottom. The development of this horizon occurred at different depths which, most probably, reflects the different drainage conditions. Roots have diameter from 0.5 upto 5 cm, the diameter of the most common roots is 1–2 cm. Roots channels are mineralized, mostly by goethite, sometimes – by pyrite. Stable isotope analysis of ^{13}C of siderite nodules shows the $\delta^{13}C$ values between −10−−11 ‰, indicating their biogenic (pedogenic) nature. Besides kaolinite, some horizons contain a number of Fe-bearing minerals: goethite, hematite, siderite, ilmenite, pyrite and also quartz. The joint presence of these Fe-minerals testifies the diverse and complicated paleoecological environments of soils formation. Organic carbon (1.25–2.25%) besides roots is presented by coaly large plant fragments of *Callixylon* – *Archaeopteris*, coaly detritus, well preserved spores. All these testify for the large biodiversity of the Devonian landscape. The obtained PSs characteristics suggest warm – wet with seasonally arid environments of their development. Soils were semi – hydromorphic with stages when oxidizing conditions prevailed. The occupation of the territory by large progymnosperm plants was not wide. At the same time they effected visibly the pedogenesis; providing the complexity of the Devonian soil cover.

References

1. Lebedev O.A., Luksevics E. and Zakharenko G.V., 2010. Palaeozoogeographical connections of the Devonian vertebrate communities of the Baltica Province. Palaeoworld 19, 108–128.
2. Krassilov V.A., Raskatova M.G. and Istchenko A.A., 1987. A new archaeopteridaliean plant from the Devonian of Pavlovsk, U.S.S.R. Review of Palaeobotany and Palynology, 53, 163–173.

RED PALEOSOL OF MARÍLIA FORMATION IN MINAS GERAIS, BRAZIL – EVIDENCE OF HUMID TROPICAL CLIMATE IN THE LATE CRETACEOUS

Diego Sullivan de Jesus Alves[1], Francisco Sergio Bernardes Ladeira[2]

[1]Student's postgraduate program in Geography, Institute of Geosciences Universidade Estadual de Campinas / UNICAMP.
João Pandiá Calógeras Street, 51 – Barão Geraldo. Zip Code 13083-870. Campinas, SP, Brazil
[2]Professor of the Geography Department, Institute of Geosciences, Universidade Estadual de Campinas / UNICAMP

The present study aims to macromorphological characterize a palaeosol preserved profile of Marília Formation in Campina Verde, state of Minas Gerais, Brazil. The research area is located in Bauru Basin [1], recognized as an important geological unit of the Brazilian Upper Cretaceous. It forms of siliciclastics rocks of continental origin with volcanic associated, and covers an area of approximately 370,000 km², with the maximum thickness recorded about 300 meters, and overlaps mainly to basalts of the Serra Geral Formation, São Bento Group [1]. In Campina Verde outcrop sediments of the Bauru Group, which is subdivided into three lithostratigraphic units, formations Adamantina, Uberaba and Marília. In the described profile, the sandy textures are predominant, with prevailing granulation of fine and medium sand. Has a thickness of 667 cm with five horizons. The dominant colors are dusty red (10R3/4), pale red (7.5R6/4), pale red (10R6/3), dark red (10R3/6), pale red (10R6/4). The horizons display only massive structures. In the horizon 1, 3 and 4, there are grains with oxide films. In the horizon 4 occurs clay nodules of 5 to 10 mm. On the horizon 5 we identified large cross stratification still preserved and smaller structures already erased by pedogenesis. The cementation of calcium carbonate ($CaCO_3$) is nonexistent in the matrix, only bioturbations occur slight reaction to hydrochloric acid (10% HCl). The bioturbations are usually abundant and filled, containing associated oxi-reduction halos. The analysis indicated the presence of kaolinite in these horizons. The morphological and mineralogical information indicate the presence of humid conditions during Maastrichtian in the area, and all the literature indicates conditions semi-arid and arid for this time of the Upper Cretaceous in the area.

Acknowledgements

To FAPESP for funding the project Paleoenvironmental reconstruction of the Marília Formation based on the study of paleosols in Campina Verde (MG) (process 2012/02587-6). To CNPq for the second author's productivity scholarship (312583/2009-5).

References

1. Fernandes, L.A.; Coimbra, A.M. A. Bacia Bauru (Cretáceo Superior, Brasil). **Anais da Academia Brasileira de Ciências**, Rio de Janeiro, 1996, p. 195–205.

LATERITIC MATERIALS AND OXISOLS IN BRAZIL – NEW SOILS ON PALEOSOLS?

Francisco Sergio Bernardes Ladeira[1], Fernanda Aparecida Leonardi[2]

[1]Professor of the Geography Department, Geosciences Institute, Universidade Estadual de Campinas / UNICAMP.
João Pandiá Calógeras Street, 51 – Barão Geraldo. Zip Code 13083-870. Campinas, SP, Brazil – fsbladeira@ige.unicamp.br
[2]Student's postgraduate program in Geography / Institute of Geosciences – Unicamp

The lateritic materials occurrence in Brazil are very common and widely mapped and treated by the literature. These materials correspond to lateritic profiles, ferricretes and deposits derived from reworking of such profiles and ferricretes, which concentrated iron and/or aluminum relative to bedrock.

Although quite common in brazilian literature there is no systematic mapping and association of these materials to geomorphological surfaces. The main objective of this study consisted in mapping the geographical distribution of these materials, its altitude occurrence, its association to the main brazilian morphostructural units and its morphological and chemical characteristics. The existing Geological and Pedological Mapping of Brazil in scale 1:1,000,000 was basic source for this work.

The surface covered by brazilian lateritic materials corresponds to 11.69% of the Brazilian territory (995,372.28 km^2), 25.4% of the area occurs over 300 meters, 45.3% between 300 and 600 meters, 28.6% between 600 and 1,000 meters and only 0.7% between 1,000 and 1,200 meters of altitude. The larger lateritic materials occurrences are concentrated in the northern and northwestern Brazil, while less significant areas are in the southeastern and northeastern and nearly nonexistent in the southern Brazil.

Soils developed from these materials are widely used in soybean planting regions in northern and central-western Brazil. These soils are usually characterized by low pH and low base saturation, however such soils display an easy mechanical management.

Mostly lateritic materials (mapped on Geological Map) correspond, in Soil Map, to the so called Latosols (Oxisols), especially Red-Yellow Latosols (central west and northern Brazil), Dark Red Latosols (central west Brazil) and Yellow Latosols (northern Brazil).

Many of the mechanical, chemical and mineralogical characteristics of these Latosols are a heritage from lateritic material, developed in the Paleogene, associated with paleosurfaces. Mapping lateritic materials can be an important tool for mapping and classification of present soils.

Acknowledgements: to FAPESP for funding the project Geomorphic Paleosurfaces Correlation of Summit in Brazil, Uruguay and Argentina – dating, morphology, cartography, deposits and associated alteration profiles (2011/23325-7), and PhD scholarship for second author. To CNPq for the first author's productivity scholarship (312583/2009-5).

TRACE AND RARE EARTH ELEMENT GEOCHEMISTRY OF THE DECCAN INTRABASALTIC BOLE BEDS (PALAEOSOLS), INDIA

Sayyed Mohammed Rafi Gulabbhai, Hundekari Sajid Mohammadhanif

Department of Geology, Poona College of Arts, Science and Commerce, Camp, Pune 411001 India.

Red and green coloured bole beds (palaeosols) intertrapped between the Deccan volcanic flood basalt sequence have been studied for the mobility of their trace and rare earth elements. They have been compared with the associated basalts (overlying and underlying) and the modern soils developed upon the basalts in Holocene. On an average red boles show higher degree of chemical weathering (CIA = 64.53) than green boles (CIA = 54.01). In general all the bole beds show depletion of trace elements like La, Ba, Zr, Y, Sr, Ga, Zn, Cu, Ni, Cr and V while enrichment of Pb, Hf, Cs, Th and Rb. While green boles show depletion in Sc, U, Ta and Nb, red boles show enrichment of these elements. Ba/Sr values indicate that green boles show higher leaching than red boles although on an average green boles are less weathered. Although the intensity of chemical weathering seems to have been independent of pH; on an average the red boles show higher weathering at comparatively lower pH than green boles. REEs show considerable fractionation and slight enrichment of REEs in red boles indicates lower pH conditions while their depletion in green boles indicates more alkaline conditions. Though in all bole samples HREE show preferential leaching over LREE relatively more enrichment of LREE in red boles indicate their higher degree of weathering which is also supported by $(La/Yb)_N$ and $(Gd/Yb)_N$ values suggesting higher HREE fractionation in red boles. All bole beds show negative Eu anomaly indicating oxidizing condition which is more pronounced in red boles. M* values have been calculated using concentrations of Mn and Fe to find out the palaeo-redox conditions. The higher values for red boles −0.06 indicate their formation in more oxic environment than the green boles −0.93. Eu/Eu* and $(Gd/Yb)_N$ ratios indicate that bole beds were not affected by intracrustal differentiation and also zircon is not an important phase in HREE.

From these observations it can be concluded that the red boles could have been formed sub-aerially under stronger oxidizing and drier-well drained conditions. The green boles, however, might have been formed in sub-aqueous environment with less oxygenated gleyed-poorly drained conditions. More leaching in green boles has been envisaged, although the weathering intensity is lower than the red boles. From their colour variations it may be proposed that the red boles were formed under sub-aerial (more oxidizing type) weathering with lower pH and higher pO_2 conditions while green boles, on other hand, were the results of sub-aqueous weathering (less oxidizing type) with higher pH and lower pO_2 conditions.

ADAPTING WRB FOR THE CLASSIFICATION OF PALEOSOLS – A LONG BUT PROMISING WAY

Peter Schad

Lehrstuhl für Bodenkunde, Technische Universität München, D-85350 Freising-Weihenstephan

The international soil classification system “World Reference Base for Soil Resources/WRB” is a system for classifying surface soils, including exhumed and surface paleosols. However, its first edition [1] provided the possibility mentioning a buried diagnostic horizon adding the word “Thapto-“ to the qualifier that characterizes this diagnostic horizon (e.g. Thaptomollic, Thaptoduric).

The second edition [2] enlarged that concept and allowed the classification of buried soils. The overlying material and the buried soil are classified as one soil if both together classify as Histosol, Technosol, Cryosol, Leptosol, Vertisol, Fluvisol, Gleysol, Andosol, Planosol, Stagnosol or Arenosol. Otherwise, the overlying material is classified at the first level if it is ≥ 50 cm thick or has undergone a significant soil formation in situ. In that case, the underlying soil is mentioned with the word “over” (e.g. Umbrisol over Podzol). In all other cases, the underlying soil is classified at the first level, and the overlying material is indicated with the Novic qualifier (e.g. 10 cm of recent sediments over a Chernozem is a Chernozem (Novic)). These definitions work well if the buried soil has not altered much after having been buried, or if the alteration was ruled by the surface soil system. This is mainly true if the overlying material is not very thick and/or has been sedimented in recent times.

We now have to enlarge our definitions for paleosols that have undergone a significant alteration after having been buried. The third edition of WRB, planned to be published in 2014, would be a good opportunity for that. WRB fulfils two important prerequisites for paleosol classification: First, (nearly) all definitions exclude climatic criteria which, of course, change with time; second, the WRB architecture of adding qualifiers to Reference Soil Groups allows the combination of characteristics developed under different conditions. But several criteria used for the definitions of diagnostic horizons, properties and materials as well as for Reference Soil Groups and qualifiers are very dynamic: acidity and base saturation, secondary carbonates and gypsum, soluble salts, reduced iron, ice, organic matter content and composition. Krasilnikov and García Calderón [3] proposed a WRB-related system, based on definitions excluding the dynamic properties and also excluding criteria using differences between horizons. Furthermore, the depth criteria for the occurrence of the diagnostics are excluded. Their system was developed according to the first edition of WRB (1998) and can now be adapted to the second edition (2006) and even to the planned third edition (2014) – although some of their definitions will need a more general revision.

During the presentation, some examples of paleosols will be demonstrated for classification.

References

1. FAO (1998): World Reference Base for Soil Resources, by ISSS-ISRIC-FAO. World Soil Resources Reports No. 84. Rome.
2. IUSS Working Group WRB (2006): World Reference Base for Soil Resources 2006. World Soil Resources Reports No. 103, first update 2007. Rome.
3. Krasilnikov PV, García Calderón NE (2006): A WRB-based buried paleosol classification. Quaternary International 156–157, 176–188.

BIOLOGICAL MARKERS IN PALEOSOLS

RECONSTRUCTION OF ENVIRONMENTAL CHANGES DURING THE LATE GLACIAL AND HOLOCENE BASED ON BIOGEOCHEMICAL DATA OF A SOIL-SEDIMENTARY SEQUENCE ALONG THE LOWER SELENGA RIVER VALLEY, LAKE BAIKAL REGION, SIBERIA

D.B. Andreeva[1], G.L.B. Wiesenberg[2], M. Zech[3], M.A. Erbajeva[4], W. Zech[5]

[1]Institute of General and Experimental Biology, Russian Academy of Sciences, Siberian Branch, 670047 Ulan-Ude, Russia, andreevad06@rambler.ru
[2]Soil Science and Biogeochemistry, Department of Geography, University of Zurich, Ch-8057 Zurich, Switzerland
[3]Department of Soil Physics and Chair of Geomorphology, University of Bayreuth, D-95440 Bayreuth, Germany
[4]Institute of Geology, Russian Academy of Sciences, Siberian Branch, 670047 Ulan-Ude, Russia
[5]Institute of Soil Science and Soil Geography, University of Bayreuth, D-95440 Bayreuth, Germany

The investigated sequence is located on the right riverbank of the Selenga River north of Ulan-Ude, Buryatia [1, 2]. Over a distance of some hundred meters it comprises several distinct buried humic A horizons with intercalated layers of greyish silty fine sand above laminated alluvial clayey sandy silt. According to radiocarbon dates, the majority of the alluvial sediments were deposited during the Late Glacial or even earlier, while the fine sand above were deposited during the Holocene. A hiatus between both units is likely. We argue that the buried A horizons developed during environmental conditions supporting higher biomass and soil organic matter production, whereas the greyish fine sand layers document colder and drier conditions with stronger winds favoring aeolian transport. To reconstruct the fluctuation of wind strength we calculated the grain size ratio (20–63 μm)/(2–6 μm) according to [3]. This ratio is always highest in the greyish fine sand layers supporting our assumption of an aeolian origin during periods of accentuated wind strength. The grain size ratio is furthermore positively correlated with the $\delta^{18}O$ values of the monosaccharides arabinose ($R = 0.73$) and xylose ($R = 0.87$) and with the bulk $\delta^{13}C$ values ($R = 0.87$) in the aeolian part (upper 195 cm) of the section, hence supporting our interpretation that these sediments were deposited during periods of climatic deteriorations with increased aridity and accentuated wind strength. In contrast, the buried humic A horizons, characterized by $\delta^{18}O$ and $\delta^{13}C$ minima, developed during more humid periods especially between 7.1–5.6 and 3.6–2.8 cal. kyr BP. The upper part of the alluvial sediments is characterized by minima of the texture ratios (20–63 μm)/(2–6 μm), minima of $\delta^{18}O$ and $\delta^{13}C$ values but by TOC maxima, presumably reflecting increased humidity at about 14.6–15.7 cal kyr BP. More positive $\delta^{18}O$ and $\delta^{13}C$ values in the lower part of the alluvial sediments likely indicate relatively dry conditions before ca. 15 cal. kyr BP. Alkane concentrations (ΣnC_{17}-nC_{35}) strongly vary between 50–4700 μg/g soil with maxima especially in the buried humic A horizons indicating periods of landscape stability with high alkane input by plant litter. Alkane molecular proxies like the ratio of n-C_{31}/n-C_{27} suggest that the organic matter of most dark humic layers mainly derived from grassy vegetation cover.

References

1. White, D., Preece, R.C., Shchetnikov, A.A., Dlussky, K.G., 2013. Late Glacial and Holocene environmental change reconstructed from floodplain and aeolian sediments near Burdukovo, lower Selenga River valley (Lake Baikal region), Siberia. Quaternary International 290–291, 68–81.
2. Andreeva, D., Zech, M., Glaser, B., Erbajeva, M., Chimitdorgieva, G., Ermakova, O., Zech, W., 2013. Stable isotopes ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$) record of soils in Buryatia, southern Siberia: Implications for biogeochemical and paleoclimatic interpretations. Quaternary International 290–291, 82–94.
3. Antoine, P., Rousseau, D-D., Fuchs, M., Hattė, Chr., Gauthier, C., Marković, S.B., Jovanović, M., Gaudenyi, T., Moine, O., Rossignol, J., 2009. High-resolution record of the last climatic cycle in the southern Carpathian Basin (Surduk, Vojvodina, Serbia). Quaternary International 198, 19–36.

INFORMATION CAPACITY OF MICROBIOMORPHOLOGIAL ANALYSIS FOR PALEOPEDOLOGICAL RESEARCHES

Golyeva A.A.

Institute of Geography RAS, Moscow, Russia, golyevaaa@yandex.ru

Microbiomorpholigical analysis is a microscopic investigation of plant tissues, detritus, phytoliths, pollen and other remains of biota for the reconstruction of ancient landscape development conditions and evolution of soils. Each microbiomorph is associated with certain types of landscape and provides information of soil development and landscape evolution. Their information capacity is different, and results for different microbiomorphs are often complementary. Every stage of soil development forms its own microbiomorph profile, and different stages profiles can be distinguished.

Paleo frost-affected and seasonal frost-affected soils of the Alexandrovskiy quarry (Russian Plain) were studied for paleoenvironmental reconstructions. The microbiomorph complexes and profiles were determined.

The previous Mikulino-Valdai climatic and erosional cycles are illustrated using silica biomorphic analysis. Distributions of sponge spicules and phytoliths have shown dynamic and stable changes during formation interglacial pedosediments (OIS 5e). Such changes of alluvial, deluvial and pedological processes formed local landscapes of the European Russia.

The main aims of this research were (i) – identification and description of a variety between phytoliths and spicules into pedosediments (OIS 5e), (ii) – identification and description of a variety between different types of phytoliths and (iii) estimation of their application for climate, landscape and vegetation reconstructions.

- ✓ Sediments beginning occurred in the conditions of a cold climate thanks of erosion.
- ✓ First half of the interglacial period was warm and dry. Meadow grasses dominated on the balka's bottom, and on a watershed – forest-steppe.
- ✓ Data of analysis have shown finishing phase of functioning this paleo balka – starting erosive processes which have led to its burial.
- ✓ The certain sequence of geomorphological processes of formation of thickness is revealed: alluvial sediments were replaced by deluvial deposits and soil formation.
- ✓ At the final stage alluvial movings of a material again started. Thus, features of process of transition from interglacial to a stage of the first cold period of a new glacial are revealed (OIS 5d).
- ✓ Studed series of ancient pedosediments have in detail reflected change of local landscapes last glacial, interglacial and early next glacial.

THE OUTLOOK OF USING SOIL FUNGI AS BIOINDICATORS IN PALEOSOL STUDIES

O.E. Marfenina, A.E. Ivanova

Soil Science Faculty, Lomonosov Moscow State University, Russia

Fungi are the important component of soil biota. They have developed a system of mycelium, reproduce numerous spores and form a number of dormant structures (chlamydospores, sclerotia). Mycobiota structure can be considered as a form of "mycological memory" of paleosols [1]. On the one hand, fungal spores and other resting structures, which have been formed in the past, can be stored in the paleosols and cultural layers for a long time. And on the other – in the paleosols and cultural layers can be formed specific fungal community, which differed from those in the mineral horizons. The main directions of mycological bio-indication can be the determination of fungal biomass structure, taxonomic and functional structure of fungal communities. The main indexes of the biomass structure are: the ratio mycelium/spores, morphological characteristics of spores and mycelium of a different type. Different types of fungal mycelium can be attributed as – melanized or hyaline and different in morphological structure in accordance with the different divisions of kingdom Fungi (Zygomycetes – coenocytic mycelium, Ascomycetes – septate, basidiomycetes – septate and with clamps). The important parameters of bioindication can be taxonomic structure of fungal communities, described as traditional and modern molecular methods. Simultaneously for the indication of the economic use of the area in the past, is important to analyze the presence of environmental and physiological groups of fungi, growing on different organic substrates. This approaches are most useful on the archeological objects, where different types and amounts of organic substances are accumulated in different parts of the cultural layer depending on economic activities. In our long term investigations we established the differences of the mycological properties of the buried horizons of late Pleistocene and Holocene (30,000–1000 yr BP) and cultural layers (VIII–XIV A.D.) from the corresponding mineral and humus horizons of natural zonal soils. In paleosols horizons and culture layers, as usually, was established the presence of septate, dark-colored mycelium and the pool of fungal spores with greater morphological diversity, much greater than that of fungal spores in natural horizons of similar depth. In buried humus horizons and the cultural layers was determined the higher diversity of communities of cultivated microfungi, comparing with upper situated modern mineral horizons. The similarities of the cultural layers and modern urban soils have been demonstrated by the biggest proportion of the everytophic species of microfungi and increased occurrence of some ecological and trophic fungal groups. In the cultural layers are accumulated the functional groups of fungi, utilizing protein substrates. According to our data, one of the best indicators group of fungi in the indication of ancient settlements are keratinophylic and coprophylic fungi. The increased abundance of keratinophylic fungi was obvious on the places of the domestic wastes, ancient streets, floors of dwelling houses, etc. The phytopathogenic fungi can be isolated on the sites, where the plant products were stored.

References

1. Marfenina Olga, Ivanova Anna, Kislova Elena, Dmitryi Sacharov The mycological properties of medieval culture layers as a form of soil «biological memory» about urbanization // Journal of Soils & Sediments, 2008, V. 8, N 5, p. 340–348.

KROTOVINAS – SOIL ARCHIVES OF STEPPE LANDSCAPE HISTORY

Dana Pietsch

University of Tuebingen, Chair of Physical Geography and Soil Science, Germany, dana.pietsch@uni-tuebingen.de

Krotovinas, burrows of small mammals, are common phenomena in steppe landscapes, and for a long time they have been a major part in the discussions on the genesis of Holocene Chernozems. Not only in the Holocene, but already in the Pleistocene burrowing animals have been very active in the Middle Russian steppe, for example *Cricetus cricetus* and *Lagurus lagurus*. Krotovinas are very valuable archives of soil biological activities, and essential when stratigraphical ambiguities have to be solved.

Using the example of the Upper Palaeolithic excavations Kostiënki and Borshchevo, Middle Russian Steppe, an integrative soil scientific approach highlights the importance of burrowing small mammals and of krotovina fillings as a result both of bioturbation and of soil erosion in the Late Pleistocene. Based on field and laboratory data of sediments inside and outside krotovinas, and new micromorphological data, the contribution demonstrates the high value of the burrow fillings against the background of soil research.

References

1. Pietsch, D. 2013: Krotovinas – soil archives of steppe landscape history. Catena 104: 257–264.

LIPID BIOMARKERS AND COMPOUND-SPECIFIC D/H RATIOS IN THE LOESS-PALEOSOL SEQUENCE KURTAK

R. Zech[1], I. Borodynkin[2], L. Danko[3, deceased], D. Montluçon[1], V. Checha[2], T. Eglinton[1]

[1]Geological Institute, ETH Zurich, CH-8092 Zurich, Switzerland
[2]Krasnoyarsk State Pedagogical University, Krasnoyarsk, Russia
[3]V.B. Sochava Institute of Geography SB RAS, 664033 Irkutsk, Russia

Lipid biomarkers are well preserved in Quaternary loess-paleosol sequences (LPS) and might provide valuable paleoenvironmental and – climate information [1, 2]. Here we present first results from the upper part of the LPS Kurtak near Krasnoyarsk, a key site spanning the whole last glacial cycle. Plant-derived, long-chain *n*-alkane and fatty acid concentrations are ~1 and 3 μg/g dry sediment, respectively, in the Trifonovo (MIS 2) and Chany (MIS 4) loess, and concentrations are even higher in the Holocene soil and the Kurtak (MIS 3) pedocomplex. Variable chain lengths patterns indicate changes in vegetation, yet without a prominent loess-(paleo)soil pattern. Preliminary D/H analyses on the fatty acids show consistently more positive δD values for the (paleo)soils and more negative values for the loess. This pattern probably mainly reflects past changes in isotopic composition of precipitation and thus paleotemperature. Evapotranspirative enrichment might modulate the signal, but doesn't seem to be the dominant control. GDGT concentrations (lipid biomarkers derived from soil bacteria) have maxima in (paleo)soils, and 'reconstructed' pH values and temperatures vary between 7 and 8, and 0 and 10 °C, respectively. The lack of a clear loess-(paleo)soil pattern suggests that interpretations of these proxies should be made with great caution, which has been found previously [3].

References

1. Zech, M., Zech, R., Buggle, B., Zöller, L., 2011. Novel methodological approaches in loess research – interrogating biomarkers and compound-specific stable isotopes. Eiszeitalter & Gegenwart – Quaternary Science Journal 60, 170–187.
2. Zech, R., Huang, Y., Zech, M., Tarozo, R., Zech, W., 2011. High carbon sequestration in Siberian permafrost loess-paleosols during glacials. Climate of the Past 7, 501-509.
3. Zech, R., Gao, L., Tarozo, R., Huang, Y., 2012. Branched glycerol dialkyl glycerol tetraethers in Pleistocene loess-paleosol sequences: Three case studies. Organic Geochemistry 53, 38–44.

BIOGEOCHEMISTRY OF ARCHAEOLOGICAL SOILS IN TRANSBAIKALIA, SE SIBERIA

W. Zech[1], D. Andreeva[2], M. Dippold[3], K. Wiedner[4], V. Tashak[5], G.D. Chimitdorgieva[2], S. Sedov[6], B. Glaser[4]

[1]Soil Science and Soil Geography, University Bayreuth, D-95440 Bayreuth,Germany
[2]Institute of General and Experimental Biology, RAS/SB, 670047 Ulan-Ude, Buryatia, Russia
[3]Department of Agroecosystem Research, BAYCEER, University Bayreuth, D-95440 Bayreuth, Germany
[4]Soil Biogeochemistry, Institute of Agricultural and Nutritional Sciences, Martin-Luther University Halle-Wittenberg, D-06120 Halle, Germany
[5]Institute of Mongolian Buddhological and Tibetan Studies, RAS/SB, 670047 Ulan-Ude, Buryatia, Russia
[6]Institute of Geology, UNAM UniversityCity, C.P. 04510, Mexico City, Mexico

Archaeological soils are wide spread in southern Siberia because this region was inhabited already during the Palaeolithic. Here we present selected biogeochemical data of 3 archaeological sites located in Transbaikalia being occupied for at least ca. 40 kyr [1, 2]. The objective of our study was to detect the intensity of human impact. The profiles Barun Alan, Henger-Tyn Skal´naya, Podzvonkaya usually have thick and dark horizons and are often rich in artifacts and bones. Soil organic C (SOC) concentrations in the dark layers of Barun Alan and Henger-Tyn Skal´naya vary between 1.2–2.9%, decreasing with soil depth. In a control site with undisturbed Kastanozems, SOC contents range from 0.7 to 2.0%. In Podzvonkaya, SOC contents are much lower (0.63–0.20%). Estimated SOC-stocks (Mg/ha) in the dark layers are: Barun Alan 1 = 340, Barun Alan 2 = 250, Podzvonkaya = 80, and in the control plot = 82. ^{13}C NMR spectra indicate pronounced aryl-C and carboxyl-C peaks, whereas in the control soil, O-alkyl-C dominates. High aromaticity may be provoked by elevated black carbon (BC) contents, means varying in the dark layers of the archaeological soils between 191–296 g kg^{-1} SOC. In the control plot, only 127 g BC kg^{-1} SOC were found. The archaeological soils under study also contain more total P (3.57–5.75 g kg^{-1}) than the control plot (1.81 g kg^{-1}). Incorporation of human feaces was detected by combined analysis of stanoles, stanones and bile acids. Dark layers showed an increasing ratio of e.g. coprostanol + epicoprostanol to coprostanol + epicoprostanol + cholestanol, reflecting input of human feaces in these layers [3]. This was corroborated by a 5–20-fold increase of lithocholic acid concentration, a characteristic bile acid of human feaces, compared to control site.

References

1. Tashak, V. 2009: Stratigraphy and chronology of Palaeolithic sites in the Hengerecte Mts. (Western Transbaikalia). History and Philology Vol. 8, issue 3: Archaeology and Ethnology, 53–62. (in Russian)
2. Tashak, V.I. 2011: Chronology of the Early Upper Palaeolithic of Western Transbaikalia (with particular reference to the materials of Podzvonkaya). Russian Annales of Archaeology 1, 100–110. (in Russian)
3. Birk, J.J., Dippold, M., Wiesenberg, G.L.B., Glaser, B. (2012). Combined quantification of faecal sterols, stanols, stanones and bile acids in soils and terrestrial sediments by gas chromatography-mass spectrometry. *Journal of Chromatography A* **1242**, 1–10.

CONTENTS

PALEOSOLS AND PEDOSEDIMENTS OF HUMAN HABITATS

PALEOSOLS, PEDOSEDIMENTS AND LANDSCAPE MORPHOLOGY AS ENVIRONMENTAL ARCHIVES

SURFACE PALEOSOLS AND RELIC FEATURES IN MODERN PROFILES. CHERNOZEMS AS PALEO-ENVIRONMENTAL ARCHIVES

PRE-QUATERNARY PALEOSOLS: PALEOECOLOGY AND POST-BURIAL CHANGES

BIOLOGICAL MARKERS IN PALEOSOLS