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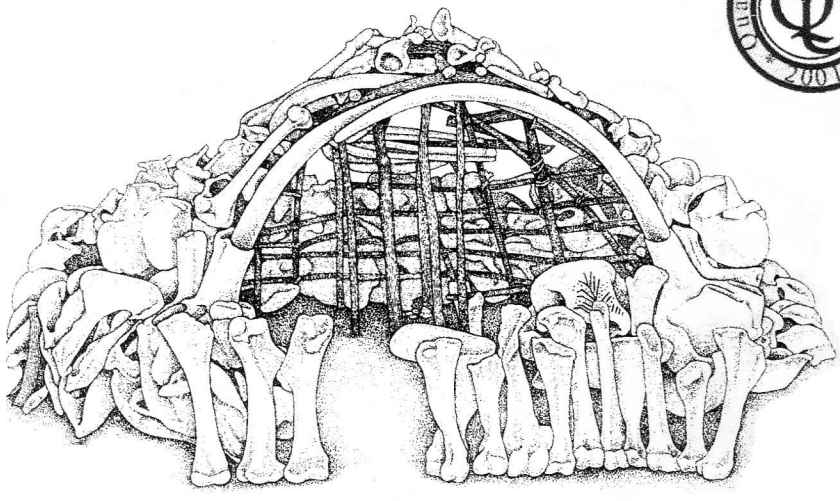

The Ukraine Quaternary Explored: the Middle and Upper Pleistocene of the Middle Dnieper Area and its importance for the East-West European correlation

Kyiv, Ukraine
September 9-14, 2001

VOLUME OF ABSTRACTS

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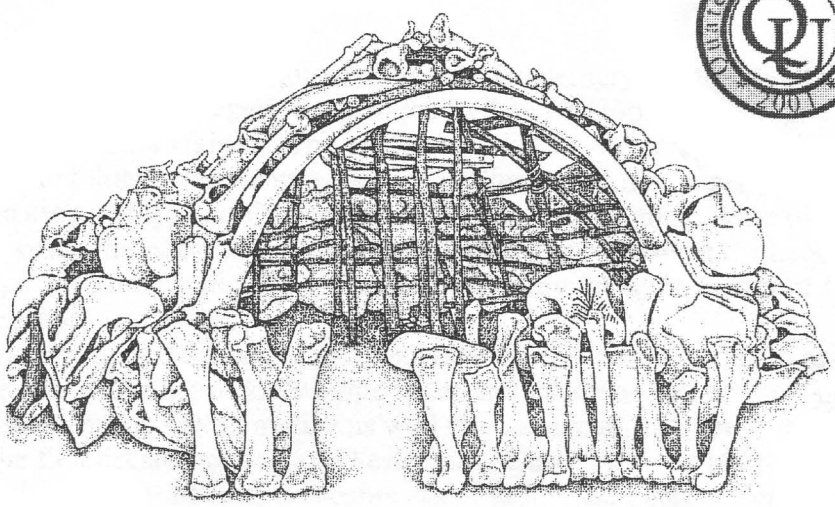

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INQUA – SEQS
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The Ukraine Quaternary Explored: the Middle and Upper Pleistocene of the Middle Dnieper Area and its importance for the East-West correlation

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For many years the Subcommission on European Quaternary Stratigraphy (SEQS) organizes during the intra- congress period of INQUA a 'local' European meeting; a meeting that in 2001 takes place in the Ukraine. The conference will focuses on loess stratigraphy, paleopedology, paleontological sequences (pollen, mollusks and mammals), glacial phenomena, Paleolithic archaeology and Quaternary dating methods. A main issue will be the interregional east-west correlation of the European Quaternary, to connect the huge dataset from Eastern Europe with the detailed investigated but mainly incomplete record from Western and Central Europe.

With the organizing of the meeting in the Ukraine SEQS intends to fulfill again one of its main tasks i.e. the exchange of knowledge between Quaternary scientists who focus their research on the European record marine as well as continental. The activities of SEQS concentrated in the first decades mainly on Western and Central Europe but thanks to the political changes, about ten years ago, it became easier to include Eastern Europe in the activities of the SEQS. However, the bad economical situation of most of the eastern European countries complicated the situation. The lack of financial possibilities prevented the participation of eastern European colleagues; however, due to the dedication of the organizers of the past meetings and the financial support from INQUA integration could be realized although in restricted dimensions. However, money alone is not enough to achieve the objectives of the SEQS. Someone has to organize a conference. It its thanks to the Organizing Committee and in particular thanks to Petro Gozhik and Natalia Gerasimenko that the conference in the Ukraine takes place. With their dedication they created the possibility to explore the Ukrainian Quaternary, a wish of many foreign colleagues. We hope that the exploration will be unforgettable for the participants and that the meeting will lead to an intensive exchange of knowledge and the establishment of future cooperation.

Thijs van Kolfschoten
President SEQS

MIDDLE–LATE PLEISTOCENIC FLUVIAL SEDIMENTOGENESIS AND GEOMORPHOGENESIS IN THE BASIN OF THE MIDDLE DNIEPER

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The Middle-Late Pleistocene fluvial sedimentogenesis and geomorphogenesis in the Middle Dnieper area are controlled by fluvial processes in the Dnieper valley and its tributaries dependent on general geomorphological, geodynamic, climatic and hydrodynamic conditions of the preglacial and postglacial development stages.

The characteristic features of the preglacial fluvial geomorphogenesis and sedimentogenesis were formed in the early Middle Pleistocene. They were controlled by the existence of a gigantic depression in place of the present Dnieper valley, by different hypsometrical positions of its eroded slopes and by the extensive distribution of lake-like basins within the area, where accumulation of terrigenous material occurred. A climate at this time was similar to subtropical one and rather wet that favoured the water excess in the area.

Early-Middle Pleistocene (Zavadivka-Early-Dnieper) alluvium in the Dnieper valley is bedded below the Dnieper glacial complex within the 4th (so called "till") terrace, as well as below the alluvia of the 1st-3rd terraces and, in particular, below the present flood-plain (the Vyshgorod, Kyiv, Trypillya regions, in the Kaniv, Vilshanka, Irdyn', Tcherkassy and other depressions).

Buried alluvium is represented by coarse channel sands, flood-plain loamy sands and loams and oxbow clays. Genetically, they are mainly lacustrine-alluvial deposits. The composition of lithofacies indicates to insignificant hypsometrical amplitudes of the preglacial relief and shows the existence of extensive river overflows, slow river currents and frequent occurrence of drained lakes. All these features were conditioned by weekly differenciated neotectonic uplift or insignificant depression of the Earth's crust in the pre-Dnieper time.

Postglacial fluvial sedimentogenesis and geomorphogenesis were controlled by the glacial erosional and accumulative relief, by an intensity of neotectonic uplift and glacioisostatical phenomena. The configuration of the river networks of the Desna basin and of some right tributaries of the Dnieper was changed at the end of the Middle Pleistocene. Though the main river has inherited the direction of the Pre-Dnieper. In the second half of Middle Pleistocene, the 3rd (Kaydaky-Tyasmyn) terrace of the Dnieper was formed.

In the Late Pleistocene, the general river network was similar to the present one, the 2nd and the 1st terraces and the flood-plain (with two levels) were formed.

The following development stages of fluvial sedimentogenesis and geomorphogenesis of the Middle Dnieper region were distinguished: the pre-Dnieper stage, when alluvium was formed under wet climate and insignificant uplift of the area (with slightly spatially differentiated tectonic movements); the Dnieper stage, when fluvial sedimentogenesis and geomorphogenesis did not occur in the glaciated area; and the post-Dnieper stage, when the relief was rebuilt under conditions of pulsating and spatially differential uplift.

CORRELATION OF UPPER PLEISTOCENE LOESS SEQUENCES FROM NORTHERN TO WESTERN GERMANY (RHINE–VALLEY)

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New research on the Upper Pleistocene loess and palaeosols sequences of north-western France are based on the analysis and on the correlation of about 100 profiles (mainly from excavations). These data allow to build a detailed reference pedostratigraphic system which is later compared with the Achenheim and Nussloch loess profiles in the Middle Rhine area.

The north-western France Upper Pleistocene loess succession is characterised by the following main points:

• The Eemian / Weichselian Early-Glacial period is represented by well developed soil complexes (Rocourt Soil and Saint-Sauflieu Soil Complex).

• **The end of the Eemian** is marked by a shift to a continental environment, contemporaneous of a strong lowering of the sea level, and by a major geomorphological crisis (erosion of the upper horizons of the soil, and deposition of clayey colluvium).

• **The first part of the Early-Glacial** is then characterised by grey forest-soils progressively superimposing on colluvial deposits, most likely during OIS 5a to 5c (complex soil Saint-Sauflieu 1, contemporaneous of a continental environment and of a boreal forest). The second part of the Early-Glacial represent the response of the continental environments at the transition between OIS 5 and 4 around 70 Ka BP. This short period of climatic instability is marked by the formation of steppe-soils (Saint-Sauflieu 2 and 3) and of the occurrence of the first aeolian local imputes (Marker).

• **The Lower Pleniglacial** appears as the first period of typical loess deposition (middle of OIS 4), but is also characterised by the occurrence of a short event of colluvial sedimentation (bedded colluvial loams with soil nodules and periglacial features).

• **The middle Pleniglacial** is then marked by a strong lowering of the loess impute and by the development of at least two brown soils horizons during the whole OIS 3 (boreal brown soils and arctic brown soils).

Finally the main period of loess deposition is related to MIS 2 and to the Upper Pleniglacial. between about 27 and 17 Ka.

These general characteristics of NW France sequences are also observed at Nussloch and at Achenheim in the Middle Rhine and allow good correlation between the two area. The main differences are represented by a best record of the Middle Pleniglacial and a huge development of the Upper Pleniglacial calcareous loess in the Rhine Valley, especially in the Nussloch profile (about 10m/10Kyrs).

MAGNETOCHRONOLOGICAL SCALE OF PALAEOSECULAR VARIATIONS AND ITS APPLICATION FOR DATING OF RECENT SEDIMENTS

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More than 30 sequences of Quaternary deposits on the territory between 59–70° N and 28–40° E were studied palaeomagnetically. They are represented by glaciolacustrine, glaciomarine, marine and lake sediments in outcrops and cores of lake and marine deposits with thickness from 2.0 to 20.0 m. According to the position of sequences relatively stadial marginal zones, reflect considerable changes of palaeogeographical setting and serve as chronological bench marks, the deposits were accumulated in the Late Weichselian and Holocene and cover the last 13 ka.

Almost half of the sequences were informative for palaeosecular variations investigations. Detailed records of declination and inclination have been obtained and correlated with palaeomagnetic data from Sweden and Finland. The radiocarbon and chronological ages of the main peaks in the Late Weichselian and the radiocarbon ages for the Holocene peaks are shown.

The age of the key point with zero declination is determined by correlation of declination-inclination curves with palaeomagnetic data from Southern Sweden which have been reliably dated by radiocarbon and varve methods. According to the Swedish geochronological time-scale, the age of the key point is 10450 ($^{+200}_{-100}$) ^{14}C years BP, or 11020 ($^{+50}_{-40}$) years. In correspondence with the age of this point, both 14Ñ and calendar ages of declination-inclination peaks of the Late Glacial are determined. The ages of Holocene peaks are determined by radiocarbon dating. The Early Holocene declination-inclination curves show the other pattern than the data from Western Europe but are well correlated with the dates from Finland. The curves at the Middle – Late Holocene intervals are well correlated with palaeomagnetic results from Western Europe and archaeomagnetic determinations for the last 5500 years from Ukraine.

No palaeomagnetic excursions have been identified for the last 13 ka. The magnetochronological scale of palaeosecular variations can be used for correlation and dating of recent sediments in Northern and Central Europe.

MIDDLE PLEISTOCENE VERTEBRATE FAUNAS OF ITALY

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The peculiarity of the geographical position of Italian peninsula, its morphology and the occurrence of physical natural barriers, had an impact on vertebrate speciations. This allows to recognize the continental Plio-Pleistocene mammal associations as Faunal Units (FUs) with a regional significance, emphasized by a different time of colonisation with respect to continental Europe. New studies of ornithological remains allow to analyse the bird taxa from a biochronological point of view, trying to propose a new biochronological scale, based on fossil bird communities and correlated together with the mammal one.

The Middle Pleistocene mammal faunas in Italy have been partially referred to two distinct Mammal Ages: Galerian and Aurelian. The Galerian Mammal Age has been divided in four Faunal Units: Colle Curti (early Galerian), Slivia, Ponte Galeria, Isernia (middle Galerian) and Fontana Ranuccio (late Galerian) (Gliozzi et al., 1997; Petronio & Sardella, 1999). The Galerian faunal renewal occurred in the late Early Pleistocene at Colle Curti FU, with the occurrence of *Megaceroides verticornis* and with the persistence of Villafranchian form Axis eurygonos (Di Stefano & Petronio, 1998), *Canis falconeri, Pachycrocuta brevirostris, Homotherium ex gr. crenatidens-latidens, Mammuthus (Archidiskodon) meridionalis,* a small sized etruscoid *Stephanorhinus* sp. and *Falco antiquus*, *Perdix palaeoperdix, Corvus antecorax.*

Among micromammals the occurrence of *Pliomys lenki* and *Microtus (Allophaiomys)*, probably the ancestor of *Microtus* ex gr. *oeconomus*, matches well with the "modern" features of the assemblage.

The Slivia F.U. is characterised by a strong faunal renewal with the first occurrence of *Cervus elaphus acoronatus, Sus scrofa, Ursus deningeri, Stephanorhinus hundsheimensis and Stephanorhinus hemitoechus.* Also the first occurrence of Bison schoetensacki and Elephas antiquus is recorded, even if doubtfully, in this FU.

The Ponte Galeria F.U. is characterised by the first occurrence of *Megaloceros savini* and *Bos galerianus* (Petronio & Sardella, 1999), and by the diffusion of *Mammuthus trogontherii* and *Elephas antiquus* (archaic form). The other taxa are less significant from a biochronological point of view and generically characterise the Galerian Mammal Age. Among the rodents *Praedicrostonyx* sp. and *Prolagurus pannonicus* have been checked (Kotsakis et al., 1992).

Isernia F.U. includes several local faunas showing both chronological and paleoecological differences. *Panthera leo fossilis* and *Megaceroides solilhacus* occur, while *Elephas antiquus, Stephanorhinus hundsheimensis* and *Bison schoetensacki* are common elements of the fauna. Among the equids, besides the persistence of Villafranchian forms, the caballoid horses appear, while some large carnivores and *Axis eurygonos* still occur.

The mammal fauna of Isernia is strongly conditioned by palaeoenvironmental factors and by the human influence. The occurrence at Isernia La Pineta of the rodent *Arvicola cantianus,* which was widespread in Western Europe from 0.6 MA (Koenigswald & Kolfschoeten, 1996), desagrees with the former biochronology of the fauna and with the

absolute dating (0.736 MA Coltorti et al., 1982). Updated analyses suggest an age of 0,6 MA (Coltorti et al., 2000). Among the birds *Tachybaptus ruficollis, Gyps* cf. *G. melitensis* and *Perdix palaeoperdix* are reported.

Finally, Fontana Ranuccio F.U. constitutes the late Galerian assemblage, characterised by the occurrence of *Cervus elaphus eostephanoceros* (Di Stefano e Petronio, 1993) and the diffusion of *Dama clactoniana*. The only Villafranchian taxa still present are a advanced form of *Homotherium* (Sardella, 1994), *Equus* ex gr. *bressanus-suessenbornensis* and *Equus altidens*. With the end of Galerian and the transition to the Torre in Pietra FU, a significant faunal event occurred: most large-sized Galerian herbivores become extinct and new little or medium sized carnivores (i.g. *Canis lupus, Ursus spelaeus*) appeared; the fauna progressively acquired modern characteristics. This renewal corresponds to important climatic modifications happening in the Mediterranean area around the OIS 11/OIS 10 transition, when the interstadial climate becomes progressively milder and the average rate of humidity increased. The occurrence of a new form and the abundance of Dama in the following Vitinia FU (OIS 8–7) is consistent with the middle climatic condition of Italian peninsula. Some new medium-sized taxa occurred, presumably at the beginning of OIS 6, when more severe and arid climatic oscillations allowed, all over the peninsula, the spread of some "mountain" caprinae (*Capra ibex* and *Rupicapra*) and the dispersion of the "steppe horse" *Equus hydruntinus*. Among pachyderms, a not advanced representative of *Mammuthus primigenius* occurred at the climatic worsening of OIS 6. Some bird taxa are also reported in the Torre in Pietra FU, like *Cygnus cygnus*, *Pandion haliaeetus, Perdix perdix, Crex crex*.

The Middle Pleistocene avifaunas of Italy contain elements that confirm the Middle Pleistocene faunal renewal, as documented in the rest of Europe (Mourer-Chauviré, 1993); for example the extinct *Perdix palaeoperdix* occurred during the Galerian, has been replaced by the extant P. *perdix* in the Torre in Pietra FU. In the other hand some differences between European and Italian bird communities are suggested by the absence in the latter of some taxa, such as *Nyctea scandiaca*. The revision of Middle Pleistocene bird material, still poorly known, will define the composition of the fossil avifaunas in the various FUs and will clarify their relationships between the Italian and European ones.

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PLEISTOCENE OF NORTHEASTERN POLAND IN CONNECTION TO NEIGHBOURING AREAS

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Stratigraphy of the Pleistocene north-eastern Poland is based mainly on palynologic analyses of buried lake organic sediments and their palaeomagnetic dating as well as on lithologic-petrographic analyses of tills and separating deposits. These data were collected from the most recent boreholes, drilled for the Detailed Geologic Map of Poland in scale 1:50 000.

In the north-eastern Poland there are 8 to 11 glacial beds. Based on geologic and lithologic-petrographic evidence, they are presumably represented by tills of 8 glaciations: Narew (Katlieriai, Narev), Nida (Nalszia in Lithuania), San 1 (Dzukija, Yaselda), San 2 (Dainava,Berezina), Liwiec (Glacial 5 in Belarus), Odra or Krzna (Zemaitija, Dniepr), Warta (Medininkai, Sozsh) and Wisla (Nemunas, Poozierie).

Substantial palynologic evidence exists for organic sediments of Augustowski (Vindziunai in Lithuania), Mazowiecki (Butenai, Alexandriya), Zbojno (Smolensk in Belarus) and Eem (Merkine, Murava) interglacials. Age determination of the Zbojno (Smolensk) Interglacial for organic sediments in the borehole Raczki Wielkie near Olecko was based on incomplete palynologic analysis only. The other interglacials, known from central and southern Poland i.e. Malopolski (Bine, Korchevo), Ferdynandowski (Turgeliai, Byelovezhian) and Lubawski (Snaigupele, Shklov) have no palynologic evidence in north-eastern Poland or its geological position and age (profile Losy near Lubawa) are under discussion.

The Ferdynandowski (Turgeliai, Byelovezhian) and the Lubawski (Snaigupele, Shklov) interglacials are presumably mostly represented by lake and fluvial facies.

PALYNOLOGICAL STUDIES OF THE UPPER PLEISTOCENE LOESSES FROM THE WESTERN REGIONS OF UKRAINE

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Materials for palynological research was collected in the Volhyno-Podilya region. The palynological characteristics of the Upper Pleistocene loesses from 10 profiles were summarized. The stratigraphical subdivision of the investigated profiles was carried out according to the regional scheme by A. Bogucki (1992). The pollen grains of herbs are dominated (65,0 to 91,0%) in spore-pollen spectra contents of the Upper Pleistocene loesses. As a rule, they are represented by Poaceae, Cyperaceae, Chenopodiaceae, Asteraceae and *Artemisia* sect. *Siriphidium*. Smaller amounts of Rosaceae, Caryophyllaceae, Ranunculaceae, Lamiaceae, Fabaceae, Plumbaginaceae, Dipsacaceae pollen, as well as *Ephedra distachya L.* were also found. The pollen grains of trees (9,0–35,0% of pollen spectra), is usually represented by *Pinus silvestris L., Betula pendula Roth, Betula pubescens Ehrh.* There are also *Betula nana L., Betula humilis Schrank., Alnaster fruticosus Ledeb., Dryas octopetalla L., Hippophae rhamnoides L., Thalictrum alpinum L., Kochia prostrata (L.) Schrad., Suaeda confusa Iljin., Suaeda prostrata Pall., Salsola soda L., Petrosimonia oppositifolia (Pall.) Litv., Ceratocarpus arenarius L., Chenopodium aristatum L., Bassia sedoides (Pall.) Aschers., Ceratoides papposa Botsch. et Ikonn., Eremogone peneticola (Klok.) Klok., Dianthus polonicus Zapal., Spergula maxima Waihe, Botrychium boreale Milde., Selaginella selaginoides (L.) Link., Lycopodium alpinum L.* etc. in spore-pollen spectra of the loesses. The palynological floras of lower layers of the Upper Pleistocene loess, the interstadial Dubno soil, the loess, the interstadial Rovno, the loess and the gleyed loess of Krasilovsk subhorizon were determined. High contents of heliophytes, xerophytes, xerohalophytes and halophytes is typical for fossil palynological floras of loesses. Palynological criteria for substantiation of main stages of the Upper Pleistocene loesses formation are presented. Genera and species compositions of fossils of Chenopodiaceae flora in Volyno-Podilya are determined, and ecological analyses of these structures are carried out. The reconstruction of a vegetational cover and climate of Volyno-Podilya at the Late Pleistocene was performed. New palynological data confirm the conclusion that the territory of Male Polissya (the plain between the Volyn Upland and Podilya Upland) is a refuge of glacial relicts.

PROBLEMS OF QUATERNARY STRATIGRAPHY OF WESTERN LITHUANIA

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The Quaternary deposits in Western Lithuania (or Lithuanian Maritime region) are found on the rocks of the Lower Cretaceous, Upper Jurassic, Lower Triassic and Upper Permian. Pre-Quaternary surface is rich in dense palaeo-incisions with their depths being within 30–40 metres on an average, sometimes reaching even 100–110 metres. The average thickness of the Quaternary makes up 50–65 metres, maximal – 130–140 metres.

Lithologically, the Quaternary thickness is generally composed mainly of till (morainic sandy loam and loam). The inter-till deposits (gravel, sand, silt, clay, gyttja, peat etc.) are distributed sporadically, their thickness does not exceed 15–20 metres, as rule. The highest thickness of the inter-till deposits (up to 80–90 metres) is found only in the palaeo-incisions. The deposits forming the relief in the northern part of the area consist mainly of till, whereas in the southern part of the area glaciofluvial, glaciolacustrine and alluvial deposits are prevailing. In the most western part – at the Baltic Sea coast – the deposits have been formed in the Baltic Ice Lake, Ancylus Lake, Litorina Sea and Post-Litorina (Limnea) Sea. The eolian formations are mostly met in the Kursiu Nerija peninsula (the Curonian Spit).

The Pleictocene deposits of Western Lithuania are subdivided into six stratigraphic units based on the data of palaeobotanic, lithostratigraphic and geochronologic investigations that were carried out during the large-scale (1:50 000) geological mapping. The interstadial deposits named Pamarys Regional Stage, composed of up to 20 metres thick fine-grained sand with organic interlayers, were distinguished referring to the data of paleobotanic investigations in the greater part of Maritime region. It was indicated that the age of interstadial deposits was 140 000–160 000 years, according to the optically stimulated luminescence (OSL) dating. The large paleo-lake in interstadial conditions is supposed to have existed at the end of Medininkai (Warthanian) Glaciation in Western Lithuania, as well as the Baltic Ice Lake existed at the end of the Upper Nemunas (Late Weichselian) Glaciation. Three till layers above and two ones below the Pamarys interstadial deposit were pointed out as well. The deposits of Merkine (Eemian) and Lower Nemunas (Early Weichselian) age were detected in a few geological sections, but all these deposits were found in the glaciodislocations, i.e. laying not *in situ*. So, the stratigraphic position and the age of till layers of Pleistocene thickness of Western Lithuania are quite problematic. If the Western Lithuania was covered by ice sheet during the isotopic stage 4, is an open question so far.

TENTATIVE CORRELATION OF THE MAIN STRATIGRAPHIC UNITS OF THE PLEISTOCENE IN POLAND AND UKRAINE

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Territories of Poland and Ukraine are situated in that part of the central-eastern Europe which was glaciated, at least partially, in different periods of the Pleistocene. At the same time, periglacial phenomena occurred almost throughout the whole area of this large region which constitutes about 10% of the European continent. Glacial and periglacial processes were registered in the deposits that provides good evidence of the Pleistocene cold stages. In this context, loesses covering extensive areas, especially in Ukraine, are very important. Numerous paleogeographical records of the Pleistocene warm stages (paleosols, swamp-lacustrine organic deposits, fluvial deposits) are also significant. Therefore, it should be stressed that the discussed area is very suitable for research work on the Quaternary.

In this paper, an attempt is made to correlate the main stratigraphic units (glacials and interglacials) of the Pleistocene in Poland and Ukraine. The results are presented in Table 1. The distinguished units are correlated with the oxygen isotope stages (OIS) registered in deep-marine deposits. Age of the chronostratigraphic units is also related to paleomagnetic data and numerous TL-ages of the Pleistocene deposits in Poland and Ukraine.

Within the whole Pleistocene (10–2600 ka BP) comprising two complete paleomagnetic epochs (Brunhes and Matuyama), there were distinguished 19 units of first range, 10 of them cold units and 9 warm units. The oldest four units (two cold and two warm ones) correspond to the Eopleistocene/proto-Pleistocene (1000–2600 ka BP), and in the examined area they occurred during a preglacial part of the Pleistocene. Glacial part of the Pleistocene (10–1000 ka BP) was subdivided into 8 glacials and 7 interglacials. First glacial was the Narevian one which covered the north-western part of Poland.

Interglacial periods are well registered by paleosols occurring in loesses. Paleosols representing all interglacials were found in the Ukrainian loess profiles. Complex structure of these soils reflects climatic oscillations during the warm periods that was also confirmed by palynological studies. Analysis of these changes allow us to correlate them with a global curve of the Pleistocene climatic fluctuations. Such a correlation can be also found for climatic oscillations within the cold periods. We think that on this basis, it will be possible to elaborate a reliable, more detailed stratigraphy of the Pleistocene in Poland and Ukraine and to distinguish units of a second range.

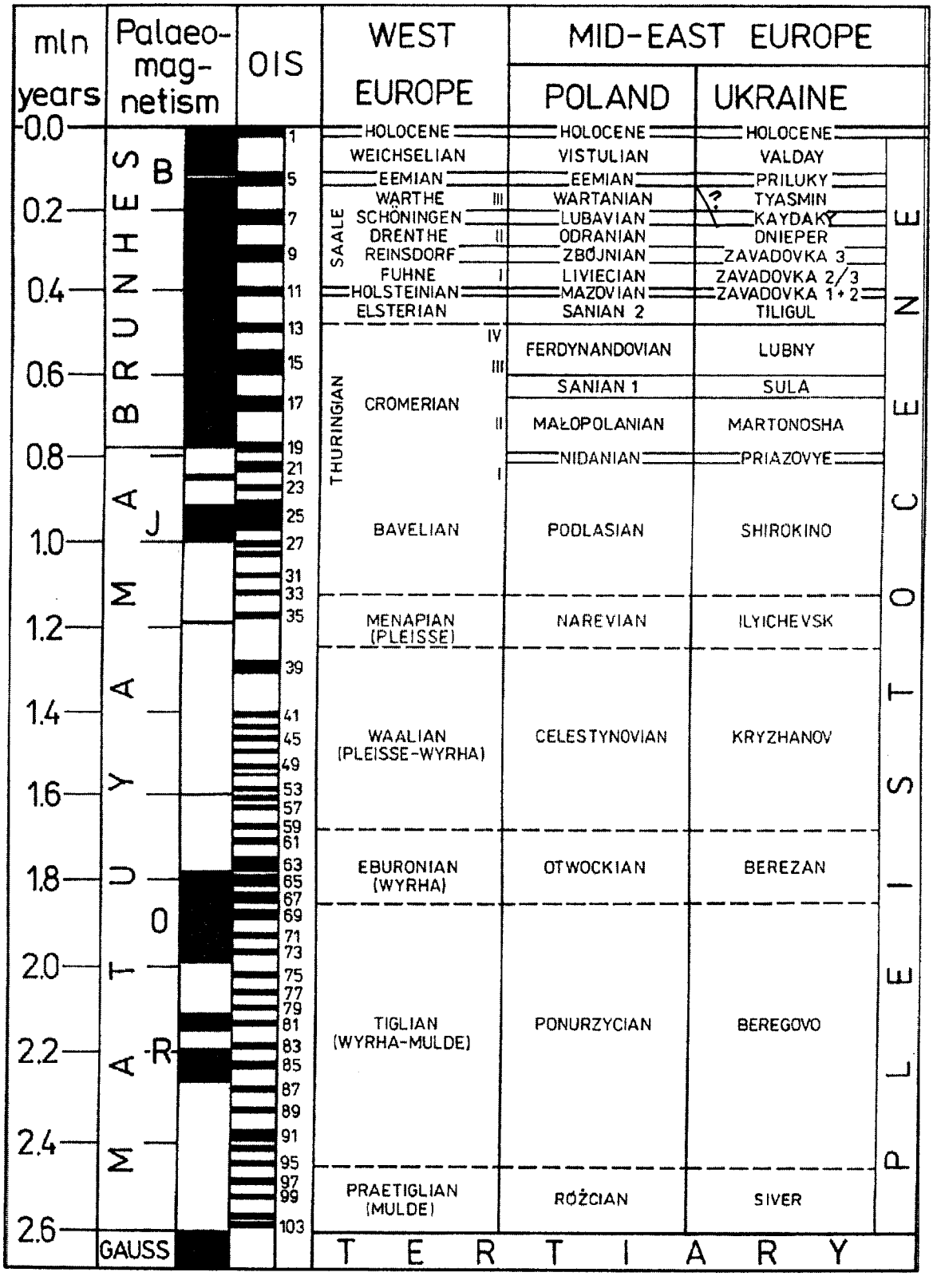

Table 1. Tentative correlation of the main stratigraphic units of the Pleistocene in Poland and Ukraine.

LONG POLLEN RECORDS AND CLIMATOSTRATIGRAPHY IN THE MIDDLE AND UPPER PLEISTOCENE LOESS-PALEOSOL SEQUENCES OF THE CENTRAL AND SOUTHERN RUSSIAN PLAIN

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The results of chronostratigraphic subdivision of the loess-paleosoil formation (LPF) of the East European Plain are presented. A correlation of basic paleogeographical events of the loess areas in the Pleistocene has been carries out.

It has been shown that the period of the LPF development on the East European Plain comprises 17 paleogeographic stages (9 interglacials and 8 glacials between them) – Petropavlovka interglacial (Interglacial I, Waardenburg), Pokrovka cooling (Glacial A), Gremyach'e interglacial (Early Illinka, Interglacial II, Westerhoven), Devitsa cooling (Inter Illinka, Glacial B, Unstrutian), Semiluki interglacial (Late Illinka, Interglacial III, Rosmalen), Don glacial (Glacial C), Muchkap interglacial (Belovezh, Interglacial IV, Noordbergum), Oka glacial (Elsterian), Likhvin s.str. interglacial (Holsteinian), Kaluga glacial (Borisoglebsk glacial), Chekalin interglacial (Kamenka, Domnitz), Zhizdra cooling (Orchik cooling), Cherepet' interglacial (Romny interglacial), Dnieper glacial (Saalian), Mikulino interglacial (Eemian), Valdai glacial (Weichselian) and the continuing Holocene interglacial. Smaller climate-stratigraphic units are identified within the glacials and interglacials: those are endothermal coolings (cold spells), thermoxerotic and thermohygrotic stages and substages of interglacial climatic rhythms; stadials, interstadials, interphasials, cryohygrotic and cryoxerotic stages and substages of glacial climatic rhythms. Endothermal coolings have been identified in a majority of interglacials.

Environment and vegetation evolution of the epochs of the loess and soil formations in the East-European loess province has been characterised by pollen data of the reference sections of the Upper Oka (Likhvin-Chekalin section), the Upper Don (Strelitsa section), the Middle Kuma (Otkaznoe section), the Middle Dniester (Molodova section, Ketrosy section) and the Middle Desna (Arapovichi section) regions of the East European Plain. The reconstructions indicate a wide expansion of periglacial tundras and forest-tundras in the central regions of the East European Plain, and dominance of periglacial steppes and forest-steppes (more rarely – tundra-forest-steppes) in the south; they also suggest a considerable complexity of succession processes in phytocoenoses evolution. Ice sheets probably covered the north of the East European Plain at all the cold stages, and occasionally penetrated the central regions of the plain. Several cold stages in the LPF development which cannot be reliably correlated with till horizons on the East European Plain resembled closely the Don (=Helmian, Glacial C), Dnieper (=Saalian) and Valdai (=Weichselian) glaciations in the scale of climatic changes and ecosystem transformations.

As is evident from the pollen data, fossil soils of the Central glacial-periglacial loess regions (Likhvin section in the upper Oka region and Strelitsa section in the upper Don region) developed in interglacial and interstadial climate; some of the soils were formed under stenoperiglacial conditions corresponding to glacial stages of glacial epochs. Loess horizons in these regions were formed in the glacial climate only. Whereas in the south of the East European LPF province (Molodova, Kishlyanski Yar and Ketrosy sections in the middle Dniester region, Arapovichi section in the middle Desna region, and Otkaznoe section in the middle Kuma region, and others), the loess horizons were formed during all the stages of glacials, including interstadials and interphasial warmings, as well as during thermoxerotic stages and endothermal coolings of interglacials. Paleosoils developed there at all stages of interglacials, and also during interstadial and interphasial warmings and cryohygrotic stages of the glacials.

CORRELATION OF LOESS-PALEOSOL SEQUENCES IN EAST AND CENTRAL ASIA WITH SE CENTRAL EUROPE – TOWARDS A CONTINENTAL QUATERNARY PEDOSTRATIGRAPHY AND PALEOCLIMATIC HISTORY

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Recent small climatic fluctuations on a 10^2–10^3 year time scale can be correlated worldwide e.g. by distinct moraines dated to about 1850 AD in similar positions below the present day glaciers in the southeastern Canadian Rockies, in the European Alps and in the Tian-Shan near Urumqi, China. These moraines result from glacier advances caused by a decline of mean annual temperature of only ≤1° C. This suggests that major climatic changes on at least a 105 year scale (glacial-interglacial cycles) and probably 10^4 year scale (the appropriate length of an interglacial) must be of similar ages throughout the temperate climatic belt of the Northern hemisphere. This concept allows continental pedostratigraphical correlations. Detailed knowledge of the genesis of paleosols is needed to establish loess-paleosol stratigraphies that can be used for paleoclimatic reconstruction. Most paleosols, however, are truncated and largely recalcified from overlying loess. Micromorphological studies allow primary and secondary carbonates to be distinguished and provide unequivocal evidence of clay illuviation. This enables the separation of typical loess, weathered loess and the recognition of different genetic soil horizons as CB, BC, Ah, Bw and Bt horizons. For the Brunhes epoch the sequence at Karamaydan, Tadjikistan, is more detailed than the corresponding sections in Luochuan, China, and even more than in SE Central Europe except for the last glaciation. The very good correlation with the deep-sea oxygen isotope record of Bassinot et al. (1994) which includes the development of an accurate astronomical time scale, allows a detailed chronostratigraphical subdivision of the loess-paleosol sequence in Karamaydan. This sequence therefore should be regarded as a key sequence for reconstructing the climatic history of the Brunhes epoch. This conclusion implies that the loess-paleosol sequences in SE Central Europe are more incomplete than thought earlier. A chronostratigraphical correlation is summarized in Fig.1. Pedocomplexes in Karamaydan correspond with single paleosols in the SE Central Europe, e.g. the F 6 paleosol in Stari Slankamen with pedocomplexes PK VI and V at Karamaydan, which were formed over a period of about 140 ka, although pedogenesis was interrupted several times by loess deposition. The F 6 soil therefore is an example of a welded paleosol as the F 5, the F 4 and the F 2 paleosols. For most of the Matuyama epoch the central and lower parts of the sequence at Chashmanigar show more pronounced paleosols than the equivalent parts at Luochuan; in SE Central Europe only in Stari Slankamen three strongly developed but truncated paleosols F 9 – F 11 above Neogene sediments are exposed. Mineralogical investigation of the silt and clay subfractions show that there is little difference in the type and amount of pedogenic clay mineral formation between the Holocene soils and the paleosols of the Brunhes epoch at Karamaydan and of the paleosols of the Matuyama epoch at the Chashmanigar. This suggests that the interglacial climates represented by the B or Bt horizons of the buried paleosols of young, middle and old Pleistocene age were similar to that of the Holocene.

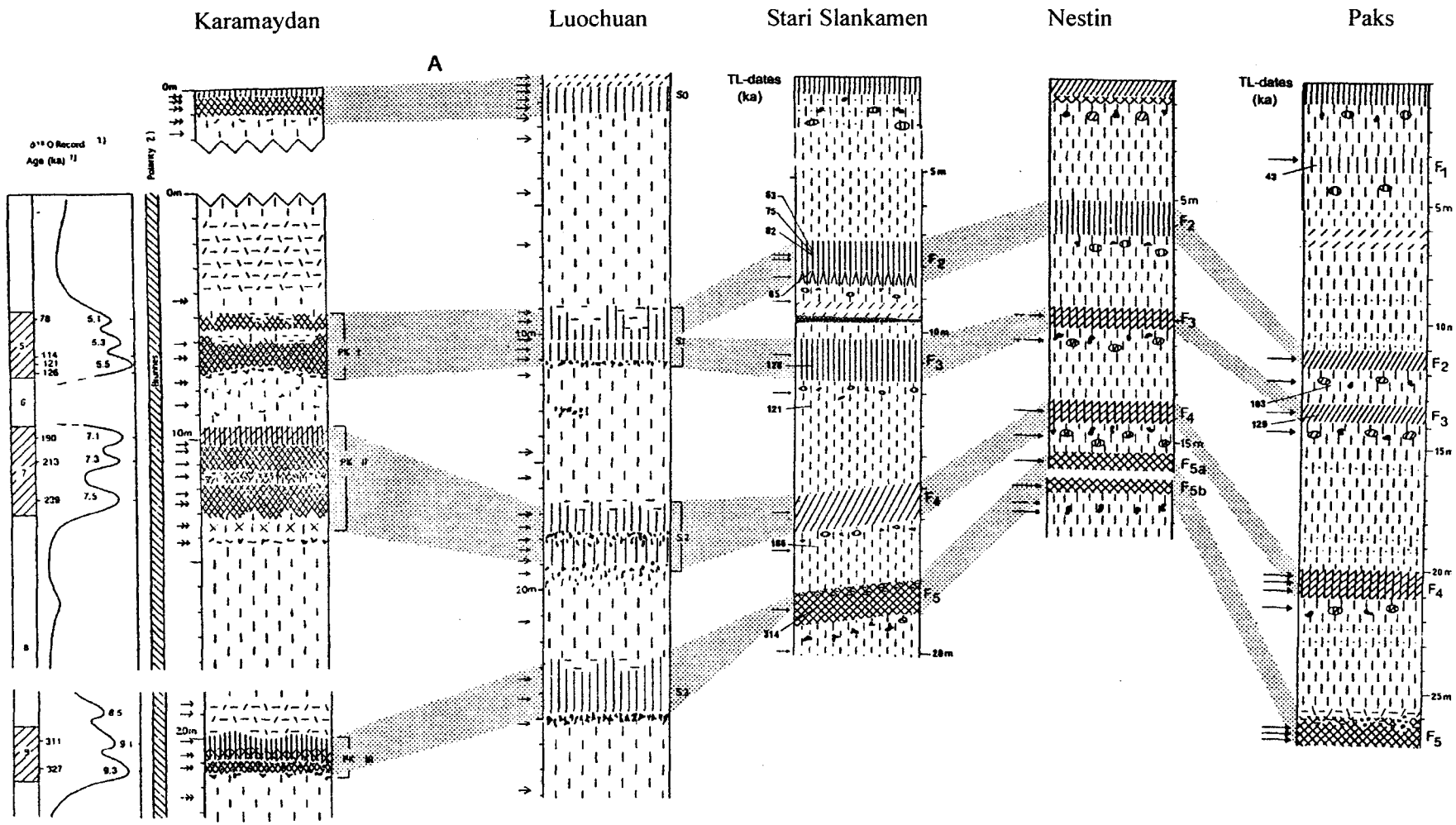
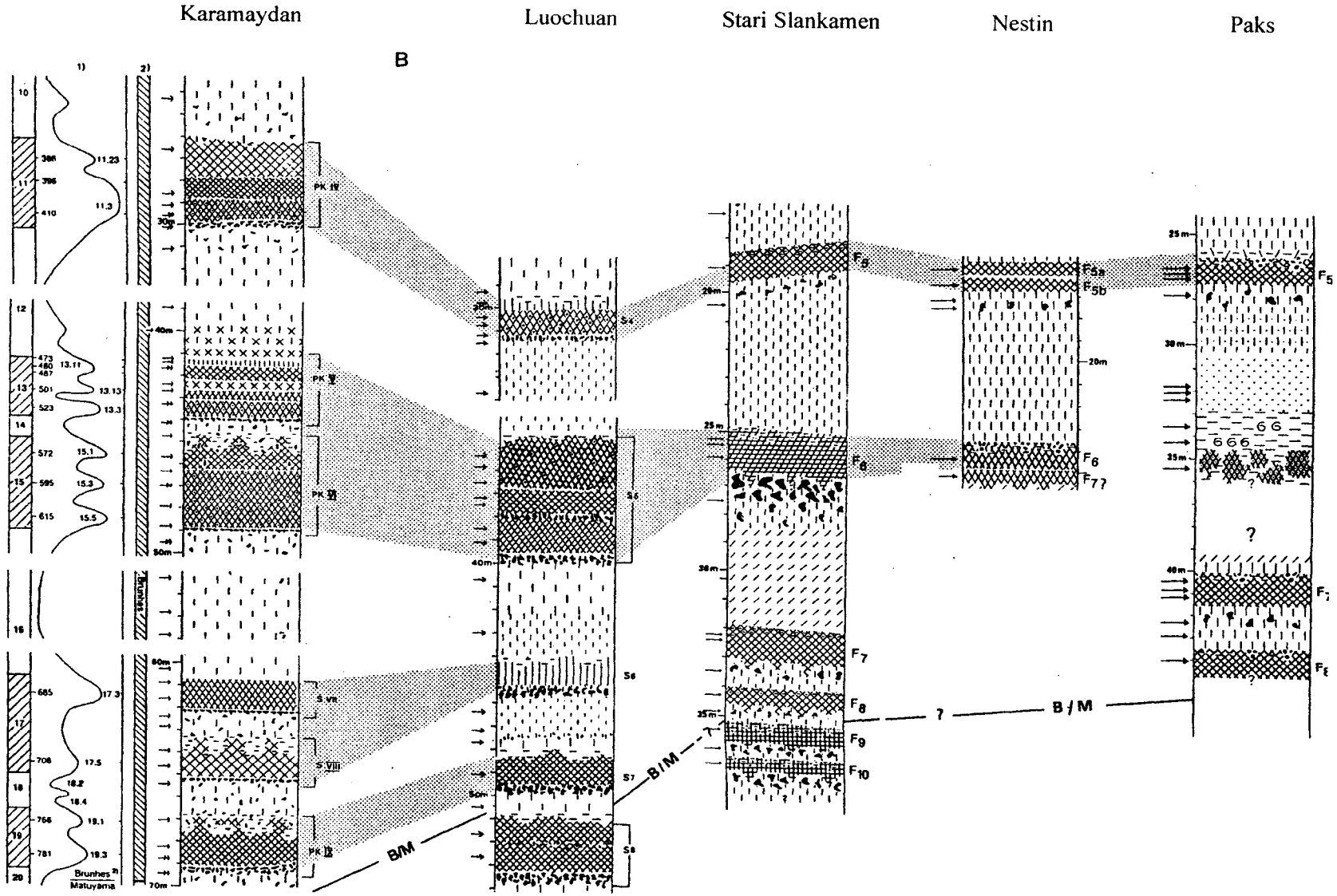


Fig. 1.
Genesis of paleosols and pedostratigraphic correlation between the sections of Karamaydan, Tadjikistan, Luochuan, China, Stari Slankamen and Nestin, Yugoslavia and Paks, Hungary.
A: PKI - PK-III Karamaydan with S-l - S3, (Luochuan) and F2 - F5a (east Central Europe)
B: PKIV - PKIX (Karamaydan) with S4 - S7 (Luochuan) and Fsb - Fs (Southeast Central Europe).


Karamaydan
Luochuan
Stari Slankamen
Nestin
Paks
B
B/M
B/M
Brunhes
Matuyama

LATE–GLACIAL AND HOLOCENE MOLLUSCS OF LITHUANIAN MARITIME REGION

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At a present time the investigations of the subfossil molluscs on the Lithuanian Maritime region are linked with geological mapping at a scale of 1:50 000 which finished last year. Well-preserved mollusc fauna has been discovered generally in the boreholes. The estimation of the isotopic composition of oxygen and carbon in the mollusc shells as well as radiocarbon (^{14}C) and optically stimulated luminescence (OSL) dating from mollusc bearing sediments have been done also. The lithological composition of mollusc bearing sediments is very different and varies from gyttja to fine-grained or medium-grained sand and gravel. The amount of subfossil mollusc varies from a few fragments to big concentration (5–10% of volume of sediments).

Late-Glacial subfossil mollusc fauna (*Armiger crista f. cristatus, Gyraulus albus, G. laevis, Lymnaea peregra, L. stagnalis, Musculium lacustre, Pisidium sp., Sphaerium lacustre, S. rivicola, S. solidum*) has been found only in the one outcrop – Ventes Ragas. These species composition of the mollusc fauna are characteristic for the nearshore of the freshwater shallow basin. Shoreline of the Joldia Sea was situated westwards from the present Baltic Sea coast, so deposits and mollusc fauna of this basin absent here. Sediments of the Ancylus Lake was established in the southern part of Maritime region, but subfossil mollusc, characteristic to this basin, have not been found. The biggest amount of the subfossil mollusc fauna have been found in the Litorina Sea deposits. In the northern part of the Lithuanian Maritime region well preserved *Cerastoderma glaucum, C. edule, C. crassum, Macoma balthica, M. calcarea, Mytilus edulis, Bithynia tentaculata, Hydrobia ulvae, Valvata piscinalis, V. pulchella,* as well a few peace of *Littorina littorea, Teodoxus fluviatilis, Pisidium amnicum* have been found. A big size of mollusc shells, especially *Macoma balthica, M. calcarea, Cerastoderma glaucum* and C. *edule*, shows the prevailing of brackish water. Content of this species are characteristic for littoral zone of brackish sea basin which salinity was 5–10‰ and depth don't exceeds 5–10 metres. The freshwater species such as *Valvata piscinalis, V. pulchella* and *Pisidium amnicum* are redeposit. In the southern part of the Maritime region only the freshwater subfossil mollusc fauna have been found. The big concentration of *Bithynia tentaculata, Valvata naticina, V. piscinalis, V. piscinalis f. antiqua, V. pulchella, Viviparus fasciatus, V. fluviatilis, V. viviparus, Dreissena polymorpha, Musculium lacustre, Sphaerium solidum, Pisidium amnicum, P. henslowanum, P. lilljeborgi, P. milium, P. moitessierianum, P. nitidum, P. pulchellum, P. supinum, Unio* sp. shows the prevailing of freshwater shallow basin, probably lagoon. The species composition of the mollusc fauna from the Litorina Sea deposits allows us to make conclusions, what while Litorina Sea existed, in the northern part of the Maritime region, where the littoral zone of brackish sea basin existed, in the southern part the freshwater shallow lagoon spreaded. Such conclusion well corresponds with data of palynological and diatom analysis as well as with results of physical dating and isotopic investigations of subfossil mollusc shells and mollusc bearing sediments.

Thus it is possible to consider that the Lithuanian Maritime region can be divide in two different parts: northern – near shore zone of the open see basin and southern – lagoon, separated by spit from the open sea. This palaeoecological situation were revealed in the beginning of the Holocene and survived up to present time.

BIOSTRATIGRAPHY OF PALEOLITHIC TYPE LOCALITIES OF THE SOUTHERN URALS REGION: FLORA, FAUNA, RADIOCARBON DATA, AND ARCHEOLOGY

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At the present there are more than 15 Paleolithic type localities in the Southern Urals region. The most part of them is located in the mountain area in karsts cavities: Shulgan-Tash (Kapovaya), Kuljurt-Tamak, Ignatievskaya, Serpievskaya 2, Muradymovskaya 1 and 2 et al. It was known that artifacts are not numerous in these localities. In flat country Paleolithic type localities are extremely rare (Gornova, Novobelokatai) and are situated in the deposits of second over-flood plane river terraces.

Only small part of cave and all terrace Paleolithic type localities are biostratigraphical studied.

Palinological investigations were done for deposits with cultural layer in cave localities Shulgan-Tash, Ignatievskaya, Serpievskaya 2.

Palaeozoological investigations were carry out in all cave localities: mammal's fauna was studied.

Next radiocarbon data were receive for cave localities: Shulgan-Tash – 14680 ± 150 y. (LE – 3434) and 13930 ± 490 y. (GIN – 4853); Ignatievskaya – 14240 ± 150 y. (SOAN – 2209), 13335 ± 192 y. (IEMEZG – 365), 10400 ± 465 y. (SOAN – 2468); Kuljurt-Tamak – 14920 ± 660 y. (LE – 4350) and 15870 ± 390 y. (LE – 3350); Serpievskaya 2 – 25200 ± 1800 y. (IERZH – 46).

The cave Zapovednaya located on the west slope of the Southern Urals. It contains unique compositions with cave-bear scales that probably were cult erection of Palaeolithic hunters. Loose eluvial-deluvial deposits are represented by yellow-brown and brown loam with numerous born remains of *Ursus (Spelaearctos) spelaeus* (28700±1000 y., LU – 3715; 37250 y., LU – 3876). Ash coal from the upper part of this section is of 12380±260 y. (LU – 3861) age. In the Leningrad time mixed leaf-coniferous forests with broad-leaf trees grew on this territory. In the Ostashkovo time forest-steppe associations predominated.

The type locality Gornova is more detailed investigated on the territory of the Southern Fore-Urals (Belaya-river, Ufa). The layer with archeological occurrences of the Late Mousterian age consists of lacustrine clay (the Leningrad time) and located in the middle part of the river terrace. Large mammals of the Upper Paleolithic complex were discovered from these deposits. Born of *Bison sp.* was dated: ?33670 y. (LU – 4153, 1998). During the sedimentation of these deposits steppe was predominated; woods of coniferous trees grew in river valleys.

The type locality Novobelokatai (Large Ik river, Novobelokatai). The layer with archeological occurrences (stone and born implements) of the Mousterian age consists of lacustrine-moor clay (the Leningrad time) and located in the lower part of the river terrace under the 15 m thick loams of Ostashkovo time. Born remains of *Bison priscus, Equus sp., Mammuthus primigenius, Coelodonta antiquitatis, Megaloceros giganteus, and Cervus elaphus ets.* were determined from this layer. During the sedimentation of these deposits forest-steppe associations with mixed forests predominated. Ash coal from this layer is of 41070±1570 y. (LU – 4149, 1998) age.

Materials of O. N. Bader, A. P. Shokurov, V .L. Yakchemovich, T. I .Shcherbakova, V. E. Shchelinsky, P. E. Nechoroshev, P. A. Kosintcev, V. G. Kotov et al. and the author's materials were used during preparing of this review.

MIDDLE-UPPER PLEISTOCENE CLIMATIC AND BIO-MAGNETIC RECORDS OF THE NORTHERN BLACK SEA COASTAL AREA

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This study was focused on loess geochronology and marine stratigraphy in the Northern Black Sea and Azov Sea shorelines (Southern Russia, Ukraine, Moldova). The interregional correlation was carried out as well. The area of the Northern Black Sea shore is characterized by the occurrence of loess-paleosol formation facially replaced by marine deposits in the South and glacial deposits in the North. Seven paleosols (or pedocomplexes) have been distinguished in the Brunhes chron in these areas. The paleosol horizons (from top downwards) Bryansk, Mezin, Romny, Kamenka, Inzhava, Vorona and Kolkotova (=Rzhaksa) are recognized in sections Tiraspol/Kolkotova Balka, Varnitsa, Khadzhimus, Nikoni/Roksolany, Pekla, Priazovskoe. The stratigraphical scheme of Velichko et al. (1992, 1997) was used. The position of the Matuyama/Brunhes reversal was determined at the base of the Kolkotova paleosol in the Khadzhimus section. The existence of the Jaramillo subchron in the lower part of loess-paleosol cover (Khadzhimus, Roksolany) allows to consider that loess forming in the studied region began about 1 Ma ago, at least. On the basis of biostratigraphical data (small mammal fauna) the age of Vorona and Inzhava paleosols was defined and their correlation with Muchkap and Likhvin interglacial horizons of Russian Plain and conventionally with stages 15–13 and 11 $\delta^{18}O$ was offered. It is worthy a new AMS 14C date (OxA–7970) of 26.760+-240 year BP from the Bryansk paleosol in the Nikoni/Roksolany section. This date clarifies geochronology for the upper part of the Roksolany loess-paleosol sequence. According to palynological data from Roksolany, the Mezin pedocomlex is characterized by predominance of forb steppes in the early phase and some extension of forest phytocoenosis in the late phase. Bryansk paleosol formation occurred under forest-steppe and wormwood steppe landscapes. During the late Valdai glacial, the forb steppes were widespread. It is important to note, that there is a considerable content of slightly weathered glauconite in loess fraction of the Roksolany section; it shows that marine shallow water deposits of Black Sea shelf, which underwent deflation during marine regressions, were one of the sources of dust material. The new U/Th dates for the Karangatian deposits in the Eltigen section serve as a good geochronological control for their correlation with stage 5 $\delta^{18}O$. The anomalous magnetic direction measured in the lower part of the Karangatian sequence (Eltigen) may be considered to represent the Blake event. The experience of loess-paleosol studying in the lower part of the Middle Pleistocene shows that fossil soils have rather complicated stratigraphical succession and the suggested variant of correlation with oxygen isotope stages has preliminary character. Additional research is required to answer the question about the degree of overlapping or splitting of interglacial soils, correlating with oxygen isotope stages.

THE STRATIGRAPHY AND SPATIAL ARRANGEMENT OF LOESSES OF SOUTHERN-POLISH MEGAGLACIATION IN SOUTH – EASTERN POLAND

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The oldest loess (LN) is identified with loess formations accumulated in the periglacial areas of the glaciations of Southern Polish megaglacial and the oldest glaciation (Narew) (L. Dolecki 1995). The loess formations from the older pleistocene which were described, were from Lublin-Wolyn Upland (A. Jahn 1946, 1952, 1956, A. Jahn and M. Turnau-Morawska 1952) and from Nowy Sacz (S. Nawrocki, A. Wojcik 1995).

The results of thorough examinations conducted on Grzeda Horodelska (Lublin Upland) allowed to present for the first time a regional stratigraphic scheme of mesopleistocene loess (L. Dolecki 1974, 1977, 1981, 1991, 1995). The stratigraphic scheme of the oldest loesses worked out by the author is an expansion of H.Maruszczak's scheme (1991) which covers the neopleistocene loesses.

The oldest of the distinguished loess levels comes from the oldest glaciation within the Southern Polish megaglacial and it is marked with LN4 symbol. Its stratigraphic position is not sure, though it is surely younger than the formations which, in Busno, are below those sediments. These formations are interpreted as eopleistocene (Z. Janczyk-Kopikowa et al. 1980) or even pliocene – according to I. Grabowska (after J. Rzechowski 1997), on the basis of palinological profile. The rest of the distinguished loess levels are: LN3b (dated TL 638–612 ka BP) – covered with till from San 1 glaciation (= Don glaciation) and LN3a – from the ending phase of this glaciation.

The oldest loesses LN3a are separated from the oldest loesses LN2b above by a soil complex named GJ4, It consists of two soils separated in the profile by the structures of solifluction and pseudomorphoses of criogenic rifts, and by a silty-clayey formation, marked with a stratigraphic symbol LN2c. It is probably a mark left by a periglacial area of one of the early stages of San 2 glaciation (= Oka glaciation).

Above the soil complex GJ4 and below the till from San 2 glaciation there are loesses LN2b dated with TL method in their highest layer: 482 ka BP.

Fossil soil GJ3b comes from Mazowsze interglacial. It was found in Kolonia Zadebce (L. Dolecki 1974, 1981, 1991, 1995) where it had developed on till from San 2 glaciation, and a silty, low-thick formation which had been accumulated during the ending phase of San 2 glaciation, and which covers the till. The formation is marked: LN2a. Above there is loess from Liwiec glaciation (LN1). In the top layer of the loess LN1 there has developed interglacial fossil soil, which is paralleled with Zbojno interglacjal and which ends the stratigraphic sequence of the oldest loesses.

MICROMORPHOLOGICAL RESEARCH OF EEMIAN-EARLY VISTULIAN BURRIED PEDOCOMPLEXS – EXAMPLES FROM POLISH UPLANDS

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Paleogeographical reconstruction of Eem interglacial and early Vistulian (=Weichselien) glaciation based on micromorphological features of poligenetical buried pedocomplexes preserved in loess sediments in Polish uplands are done still very rarely.

Micromorphological research has been carried on four loess profiles: Odonow (Proszow Plateau), Zarzecze (Carpathian Foothills), Sasiadka and Tyszowce (Lublin Upland). All of analysed pedological units are very recognisable and have big differences of features and pedogenic processes which testify about continental character of climate in eastern and central part of Polish uplands. Examined pedocomplexes contain two main elements:

• lower part – well developed interglacial soil GJ1 (dated by TL method for 130/125 – 115/110 ka BP) formed on upper older loesses (LSg) with preserved sequences of diagnostic horizons: A (strong destroyed and modified by periglacial processes)–Ee–Bt–C or Cca, and

• upper part – younger interstadial soils Gi (115/110–100 ka BP) developed in early Vistulian.

The examinations of thin sections under petrological polarizing microscope, preceded by physical and chemical analysis, have concentrated on characteristics of pedogenic processes recorded in diagnostic horizons. As suitable levels are admitted two horizons: Bt (argillic) for interglacial soils and A (mollic) for younger (upper) interstadial soils.

Micromorphological examinations have concentrated on three main components:

• skeleton – mineral grains (>0,002mm), there are mainly quartz, feldspar and heavy minerals;

• plasma (<0,002mm), which consists clay minerals, oxides and hydroxides of e.g. iron and manganese and also carbonates;

• other features, especially the numerous forms made during sediment transformation caused by pedogenic and periglacial processes.

The main information about pedogenic modifications is included in plasma. This fraction is the most mobile and susceptible for transformations from all groups of soil material.

The pedogenic processes are more advanced in the lower part (interglacial soil) of pedocomplexes. In the thin sections from this soil there are a lot of charcoal and Fe–Mn microconcetraions. The carbonates (second forms) are only in Cca horizons, it is caused by decalcification of upper soil horizons connected with illuviation processes (lessive) and specific separation of clay minerals and iron oxides. The degree of advanced of pedogenic processes (illuviation) is well reflected in forms of plasma separation (mainly lattisepic) in Bt (argillic) horizon.

In the diagnostic A horizon of interstadial soils are much more capacity of organic material (mullicol and mulliskel), less carbonates and transformation of plasma without distinct tracers of illuviations into the deeper soil horizons.

Research results have showed that both soil types have dissimilar micromorphological features. Recorded on the thin sections different character of pedologic processes reflects diversity of climatic conditions between Eem interglacial and worm interstadial periods of early Vistulian glaciation.

FOSSIL VIVIPARIDAE AND CORRELATION OF TERRACE DEPOSITS

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Alluvial, lacustrine and lacustrine-estuarine deposits often contain *Viviparidae* remains. This provides the base for correlation of terrestrial and marine deposits. The investigation of *Viviparidae* of terrace alluvia formed during the whole Pleistocene is most important. This permits to trace and understand Viviparidae spatial evolution which includes evolutionary changes and migration processes affected by environmental and climatic changes.

At the start of the Pleistocene, during the formation of the X-th terrace alluvia, the fluvial fauna of Ukraine was taxonomically (specifically) monotonous (*V. subconcinnus, V. craiovensis, V. achatinoides kujalnicensis*) that indicates more moderate climate than during the previous stages. The fauna originated from the boreal zone. During the Eopleistocene (time of formation of IX–VII terraces), the pressed-conical viviparids (*V. turritoides, V. bythinicus, V. kagarliticus artus etc.*), the immigrants from the southern regions (the Balkan Mountains and Asia Minor), were widespread. Obviously that was caused by the improvement of climate. In the Early Neopleistocene, in spite of two expressive waves of cold climate comparable with the Ice Age of the Northern Europe, the conical viviparids continued their development during the interglacial intervals and became extinct only in the Middle Eopleistocene. They are present in the estuarine deposits of the Late Chaudian.

Since the Middle Neopleistocene, the Ukrainian water reservoirs are colonized by representatives of the boreal zone due to a general cooling (*V. diluvvanus, V. fasciatus, V. sokolovi, V. viviparus*).

THE BIOSTRATIGRAPHIC SUBDIVISION OF THE MINDEL-RISSIAN INTERGLACIAL SEDIMENTS ACCORDING TO OSTRACOD FAUNA

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The continental fluvial deposits in the territory of Ukraine have been studied in details. They form the alluvium of the Vth, IVth, IIIrd, IInd end Ist terraces of the Danube, the Dnieper and its tributaries and contain ostracod fauna. Its migration started at the beginning of the interglacial from south-western regions to the north and east. At the beginning of the Dnieper Glacial, *Limnocythere usenensis* became extinct in the whole area of Ukraine. According to the extensive geographical distribution (Eastern Europe) and delimited stratigraphic position (the Mindel-Riss interglacial) of *Limnocythere usenensis* species, the biostratigraphic *Limnocythere usenensis* zone ("Taxon-Range-Zone *Limnocythere usenensis*") is identified in Quaternary. Cross-sections near Gun'ky village (the Psel, the left tributary of the Dnieper) and Ozerne village (the Jalpuch, the left tributary of the Danube) are determined as the complex stratotype of the *Limnocythere usenensis* biostratigraphic zone. Strata containing ostracod fauna have been identified above and below the biostratigraphic zone in the complex stratotype of the Quaternary sediments of Ukraine. Strata containing *Potamocypris schaudae*, *Potamocypris mocrousensis* are below the *Limnocythere usenensis* zone. They form the Vth terrace of the Danube (cross-section near Nagorne village, the lake Kahul). Strata containing Limnocythere sanctipatricii are above the *Limnocythere usenensis* zone. They form the IIIrd terrace of the Dnieper (cross-section near the village of Vyshenky). The proposed biostratigraphic ostracod units will supplement the regional stratigraphic scheme with a new faunistic group which is important for correlation of local stratigraphic units.

LARGE MAMMALS AND QUATERNARY STRATIGRAPHY OF THE SOUTHWESTERN SIBERIA (KUZNETSK BASIN)

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In Western Siberia, the most diverse Quaternary sediments (in terms of composition and age) were studied in the Southeastern part of the region – in the Kuznetsk basin. Important material on large mammals is represented here in the most complete stratigraphic sequence. This allowed to trace successive stages of development in the major groups (Elephantidae and Equidae). These facts allowed to carry out a finer subdivision of sediments, to refine the local stratigraphical scheme, to establish both periglacial and interglacial faunas and to correlate them with climatic/stratigraphic horizons of West-Siberian and General stratigraphical scales (Table 1).

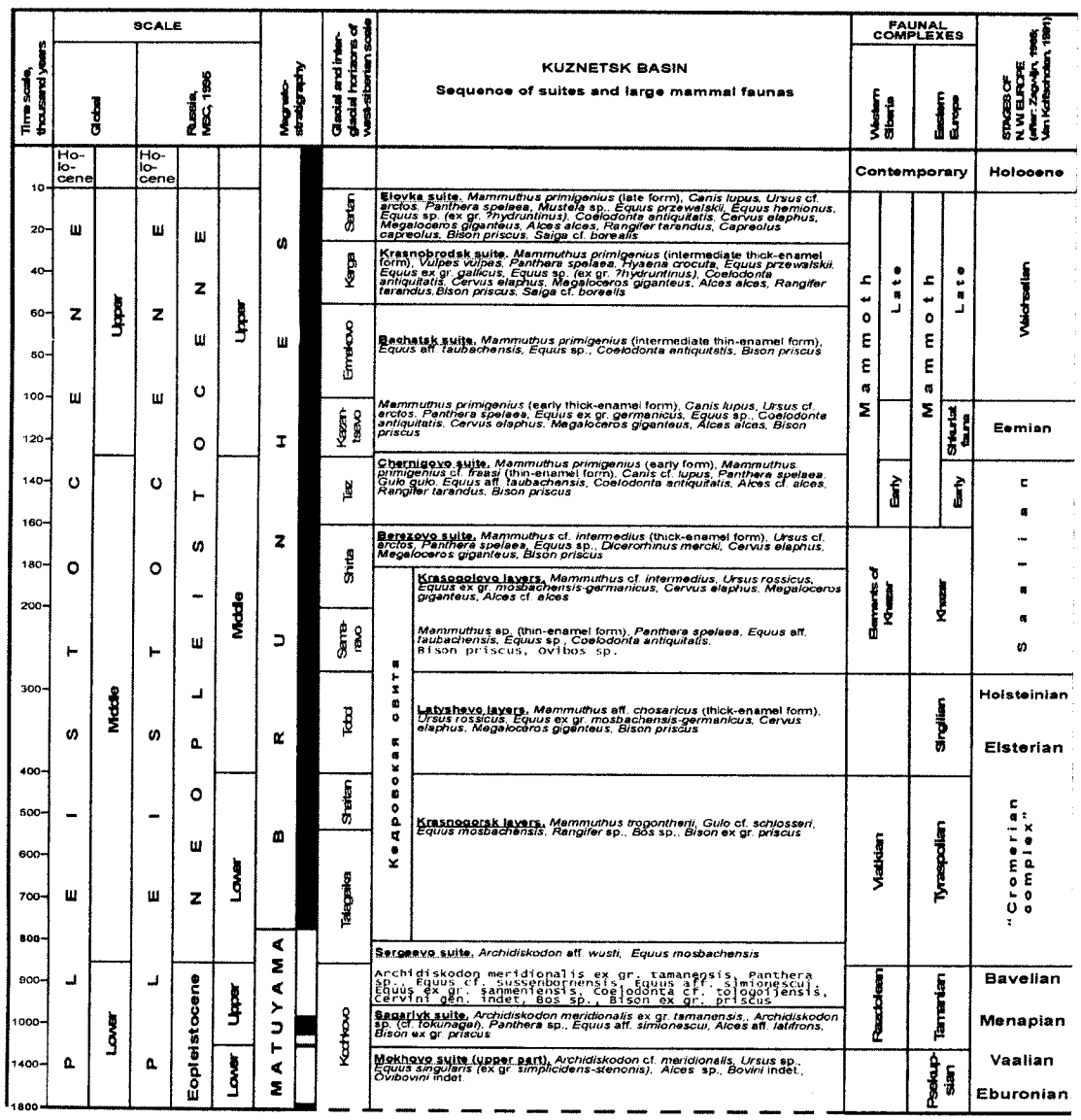

Table 1. Biostratigraphy of Quaternary sediments in the Kuznetsk basin.

CYRTODARIA ANGUSTA AND THE EARLY PLEISTOCENE ARCTIC WATERS

Svend FUNDER

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In the Late Neogene and Early Pleistocene, the northern Atlantic and Eurasian coastal waters were inhabited by a large bivalve, *Cyrtodaria angusta* (Nyst and Westendorp, 1839), which since has become extinct. During the last phase of its species-life it adapted to cold conditions and lived along the arctic shores as witnessed by faunas in the Kazantsevo beds in central Siberia, the Breidavik beds of northern Iceland, and borings in northern European Russia. Recently scattered occurrences of exposures with marine sediments with *Cyrtodaria angusta* have also been discovered in European Russia, on Svalbard, and possibly in Greenland, showing that it was a widespread and important component in the old world Arctic shallow water faunas. Unfortunately the dating of the occurrences is not precise. On Iceland its demise is dated to c. 1 ma. This agrees with amino acid ratios and palaeomagnetic results from the other areas, although some evidence has been interpreted to indicate that *Cyrtodaria angusta* may have persisted into the Mid Pleistocene. Pending better dating it is suggested that *Cyrtodaria angusta* is an indicator for the Early Pleistocene in the arctic. The faunal assemblages found togeher with it – composed of extant species – indicate shallow marine conditions very similar to the present, and yield a rare glimpse into the early Pleistocene nearshore arctic environments.

LATE PLEISTOCENE LOESS-SOIL AND VEGETATIONAL SUCCESSIONS OF THE MIDDLE DNIEPER AREA

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According to the Ukrainian Stratigraphical Framework of the Pleistocene (Veklitch *et al.*, 1993), there are 4 main loess units and 4 paleosol units above the Dnieper (Saalian) unit. From bottom to top, the soil units are Kaydaky, Pryluky, Vytachiv and Dofinivka, loess units are Tyasmyn, Uday, Bug and Prychernomorsk. The following sequence of soils and the corresponding vegetational succesion is characteristic for the complete sections of **Kaydaky unit** (kd): ferrigenous gley or turf gley soils – *Picea* forest (kd_{1a}), light loam – *Pinus-Betula* forest (kd_{1a-b}), Bt and A2 horizons of brown podzolised soil (parabraunerde) – *Pinus* forest with admixture of *Ulmus* and *Quercus*, then *Ulmus-Quercus* forest/forest-steppe (kd_{1b1}), A1 horizon, or chernozem – Herbetum mixtum-Gramineae steppe (kd_{1b2}), Bth and A2 horizons of grey forest soil – *Quercus-Carpinus* forest, A2 horizon – *Pinus* forest with broadleaf species and *Picea* (kd_{3b1}), chernozem – *Betula-Pinus* forest-steppe (kd_{3b2}). The vegetational succesion of the Kaydaky unit resembles that of the Mikulino (Eemian) interglacial (Grichuk, 1972; Bolikhovskaya, 1995), though shows features of vegetational development in a drier climate (NAP is higher). **Tyasmyn unit** (ts) is a thin loess/loam formed under *Atremisia*-Chenopodiaceae steppes (Turlo, 1975) which corresponds to the Early Glacial stadial.

The soil-vegetational succesion of **Pryluky unit** (pl) is as following: turf-chernozem soil – meadow steppe (pl_{1a}), B horizon of forest soil – *Carpinus-Quercus* forest/forest-steppe (pl_{1b1}), A1 horizon, or chernozem – meadow steppe (pl_{1b2}), loess/loam – Gramineae steppe (pl_2), turf-carbonate soil – *Artemisia*-Gramineae steppe (pl_{3a}), boreal brown soil – *Betula-Pinus* forest with few broadleaf species ($pl3_{b1}$), turf-carbonate soil – Gramineae steppe (pl_{3b2}). The pl_1 and pl_3 subunits can correspond to the Early Glacial interstadials, separated by a stadial (pl_2). **Uday unit** (ud) is TL-dated to about 70 kyr BP (Gozhik *et al.*, 2000). The loess was formed under Gramineae-Herbetum mixtum steppe. Few acro-boreal plants appeared.

The soil-vegetational succesion of **Vytachiv unit** (vt) is as following: brown gley soil – *Pinus* forest with admixture of broadleaf species (vt_{b1}), loam – Herbetum mixtum-Gramineae steppe (vt_{b1-2}), boreal brown soil – *Pinus* forest with admixture of broadleaf species (vt_{b2}), loess – Gramineae steppe (vt_{b2-3}), turf soil – meadow steppe, *Tilia* in gullies (vt_{b3}). As the upper soil is ^{14}C-dated to 31–32 kyr BP (Gerasimenko, 1999), the Vytachiv unit possibly corresponds to the interstadials of the Middle Pleniglacial, separated by the stadials. **Bug unit** (bg) consists of the lower subunit (bg_1) which includes several embryonic soils separated by loesses, and of the upper subunit (bg_2) of homogenous loess. The embryonic soils were formed under boreal forest-steppe, bg_1 loesses – under Gramineae steppe, the bg_2 loesses – under *Artemisia*-Gramineae steppe. **Dofinivka unit** (df) is a thin chernozem formed under *Artemisia* steppe, or a thin brown soil of boreal forest-steppe. **Prychernomorsk unit** (pc) is a thin loess formed under *Artemisia* steppe. The above three units have pollen of arcto-boreal plants, and can be correlated with the Upper Pleniglacial and Late Glacial.

STRATIGRAPHY AND CORRELATION OF THE PLEISTOCENE LOESS–PALEOSOL SEQUENCES IN THE DNIEPER, THE DON, THE MIDDLE VOLGA AND THE UPPER KAMA BASINS

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On the basis of detailed pedological data obtained from the most representative and thick sections of the loess-palesol formation (Chekalin, Mikhailovka, Uryv, Korostelyovo, Komintern etc.), the stratigraphic subdivision and correlation of Middle-Upper Pleistocene deposits have been carried out for the above-mentioned regions. The evolution of pedogenesis and climate of the East-European glacial-periglacial and extraglacial zones during the Pleistocene has been reconstructed.

Within the Brunhes epoch, 8 interglacial climatic rhythms (Early-Illinka=Cromer II, Late-Ilinka=Cromer III and Muchkap=Cromer IV at the Early Pleistocene; Lichvin s.str.=Holstein, Kamenka and Romny at the Mid Pleistocene; Mikulino=Eem and Holocene at the Late Pleistocene) have been identified, as well as 7 glacial (or cold climate) rhythms.

Complex studies of morphogenetic and geochemical properties of buried soils show expressive individual features of paleosols of different geochronological stages of Pleistocene, connected with a different types of ancient pedogenesis. It also show a similarity of typological features of soils formed during the same time intervals, and their regional differences connected both with geographical situation and geological-geomorphological conditions. These results enable to suggest that the soil formation during the Early Pleistocene was mainly of subtropical type (meadow-chestnut, red-chestnut (chernozem-like), meadow-chernozem-like soils), during the Mid Pleistocene – subtropical and temperate type (brunizems, brown-forest-like and chestnut-like paleosols), during the Late Pleistocene – of an arid continental type. Interstadial soils of this period were characterized by humus accumulation and cryogenesis. The Mikulino interglacial was charcterized by pedogenetic processes of a temperate type, similar to the modern one. Soils of forest and steppe types were widespread during that period.

NEW GRAPHIC INTERPRETATION OF THE MINERAL COMPOSITION OF THE BUG LOESS (LATE VISTULIAN) FROM THE MIDDLE DNIEPER DRAINAGE BASIN (UKRAINE)

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The mineral composition of the investigated loesses from the middle Dnieper drainage basin (transparent heavy minerals and light fraction) is qualitatively comparable in all sections, with crucial differences characterizing the quantity of particular mineral groups or the content of some components. All samples contain carbonates and microfossils (foraminifers) as well as glauconite and heavy minerals representing all the sub-groups distinguished on the basis of their resistance to weathering or susceptibility to eolian transport. The content of glauconite is lowest in samples from the Bugaivka section (0,5–1,0%), and highest in the Kanev section (16,0–42,5%). In samples from the basement rocks, glauconite occurs in high quantities, in some cases dominating the mineralogical content of samples from the JK section (16,0–50,0%) and GP section (70,0%). The spatial setting of the investigated loess sections and pre-Quatemary basement rocks indicates close vicinity of the Kanev loess section (Ka) to the Kostanetsky Gorge section (JK) with Tertiary deposits, and of the Andrusovka (An) and Gradizhk (Gr) loess sections in relation to the Pivikha Mt. (GP) Tertiary sands. In both cases, the basement rocks as well as loess sections contain the highest quantities of glauconite. This might indicate the influence of the local basement rocks on the mineral composition of loesses accumulated in close proximity of alimentation sources.

In turn, the westernmost Bugaivka section (Bu) is characterized by the lowest content of glauconite, indicating thus lack of contact with the JK and GP sections situated in the southeast of the investigated area.

This setting allows with some certainty to exclude loess material transport from the east to the west, because in the latter case the content of glauconite would increase in sections situated to the west from GP and JK. In reality, an opposite situation takes place, where the content of glauconite decreases westwards.

Within the transparent heavy minerals, an interesting relation is observed n the group of minerals poorly resistant to weathering (amphibolcs, pyroxenes). In most loess sections, the content of these minerals is higher in the upper (younger) samples in comparison to the lower (older) samples. This might indicate that loesses in the lower (older) samples contain material from areas, which were longer subject to weathering processes. Taking into account that the areas in question were composed mainly of glacial and Huvioglacial deposits from the Dnieper Glaciation, and the age of the investigated loesses corresponds to the younger part of the last glaciation (Vistulian – Valday, Bug loess), the weathering processes leading to the formation of this material must have taken place during the interval of ca. 250 thousand years. The higher content of poorly resistant minerals in the upper (younger) samples is probably a result of blowing out of the deeper glacial and fluvioglacial deposits, which were not subject to weathering processes. Therefore an inversion of the primary section of deposits composing the alimentation zones of loess silt must have taken place, Data on the occurrence of glauconite and minerals poorly resistant to weathering indicate the prevalence of western or north-western winds accumulating the Bug loess in the middle Dnieper drainage basin.

The tendencies can be well traced on the graphic presentation of the spatial distribution of particular mineral groups, especially of the platy minerals group as most susceptible to eolian transport. They indicate a direction referred to here as the *eolian vector* – marked IV on the diagrams, situated on the horizontal axis. The group of opaque minerals, marked VI, indicates an opposite vector, and represents minerals with high specific weights, and with morphological forms least susceptible to eolian transport. Minerals poorly resistant to weathering (amphiboles and pyroxenes), undergoing intense de fragmentation and weathering, are genetically linked with the host rocks. Their occurrence in the mineral composition during transport as well as occurrence in the heavy mineral content indicates source areas representing debris of magmatic rocks or glacial and fluvioglacial deposits rich in fragments of these rocks, situated in close proximity.

THE UPPER AND MIDDLE PLEISTOCENE OF UKRAINE

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The Sratigraphical framework of Pleistocene of Ukraine has been elaborated by the large research team under the leadership by M. Veklitch (1993). The framework is based on multidisciplinary study of more than 100 key sites. 8 main loess units and 8 paleosol units are identified above the Brunhes-Matuyama boundary: 4 paleosol units and 3 loess units below the Dnieper (Saalian) unit, and 4 paleosol units and 4 loess units above the Dnieper unit.

The lowermost Martonosha unit consists of two soils separated by a loess. The reddish soils, rich in clay and iron sesquioxides, were formed under climate similar to subtropical one, with abundant but not regular precipitation. Martonosha unit has the richest dendroflora with diverse Tertiary relics. In the north, dark-conifer forests, and particularly *Abies*, were typical. TL-age of Martonosha unit is 720–680 ka BP.

The next Lubny soil unit was formed under temperate climate. The unit includes two pedocomplexes: each from the lower forest soil and the upper chernozem-like soil. During the Lower Lubny, the vegetation mainly consisted of *Quercus* and *Quercus-Carpinus* forests. The sharp reduction of Tetiary relics was characteristic. During the Upper Lubny, meadow steppes spread. TL-age of Lubny unit is 510–480 ka BP.

Zavadivka unit consists of two pedocomplexes. In the north and east of Ukraine, the soils were formed in a warm-temperate belt. In the south of Ukraine, the soils were similar to subtropical ones. The warmest and most humid climate existed during the Early Zavadivka which is correlated with Holsteinian. During the climatic optimum, broadleaf forest spread dominated by *Carpinus*. Fagus and Tertiary relics occurrred. Climatic conditions of Upper Zavadivka were colder and drier. The TL-age of Lower Zavadivka is 440–380 ka, of Upper Zavadivka – 370–340 ka BP.

Potyagaylivka unit is a pedocomplex from the forest and chernozem-like soils of temperate climate (in the south, from reddish-brown soils). Broadleaf forest spread during the climatic optimum, though mesophytes (*Carpinus, Abies*) were not present.

The Middle Pleistocene loess units are Sula, Tyligul, Orel and Dnieper. Dnieper loess is richest in silt, Sula loess – in clay. Loesses were formed under periglacial steppe in the north of Ukraine, and under xeric steppe in the south. The TL-age of Sula unit is 640–600 ka, of Tyligul unit – 510–440 ka, of Dnieper unit 260–240 ka BP.

Above the Dnieper till, two soil units – Kaydaky and Pryluky – consist of the lower forest soil and the upper chernozem, and are closely connected in a sequence. The thin Tyasmyn loess unit separates them only in paleodepressions. The lower forest soils of both units were formed under broadleaf forests with *Carpinus*. The pollen succession of Kaydaky unit resembles that of Mikulino (Eemian) interglacial. In the Pryluky forest soil, all broadleaf species appeared early and almost together. Kaydaky unit is correlated with the last interglacial, Tyasmyn and Pryluky units – with stadials and interstadials of the Early Glacial. The TL-age of Pryluky-Kaydaky units is 150–100 ka BP. The older ages 180–167 ka BP – may show the age of soil substrata: Dnieper loesses transformed by clay translocation. In some sections of the non-glaciated area of Ukraine, Kaydaky and Pryluky

units are separated by Tyasmyn loess up to 3 m thick. Here Kaydaky unit can correspond to MIS 7. Problems of the interregional correlation are not finally solved.

The Uday loess unit is TL-dated to 70–58 ka BP and correlated with MIS 4. The unit was formed under more mesophytic steppe than the next loess units, with cryophytes in the north of Ukraine.

Vytachiv unit is TL-dated to 44–35 ka, and ^{14}C-dated – to 33–30 ka BP. It is correlated with MIS 3, and consists of 2–3 interstadial soils with loess interlayers. In the north of Ukraine, the soils are rich in clay and iron sesquioxides, in the south of Ukraine, they are carbonate, often with gypsum. The lower soils were formed under boreal forest-steppe, the upper soils – under mesophytic steppe in the north, and xeric steppe in the south.

Bug, Dofinivka and Prychernomorsk units are dated younger 27 ka BP and correlated with MIS 2. Bug loess is the thickest one (up to 18 m), whereas the Prychernomorsk loess is thin. Dofinivka unit consists of weakly developed chernozems, or brown semidesert soils in the south. They were formed under boreal steppe in the north and xeric steppe in the south of Ukraine. ^{14}C age is 13,7–16,1 ka BP.

Two Middle Pleistocene tills, older than Dnieper (Saalian) one, were discovered in the north-western Ukraine. They are correlated with Tyligul and Sula units of the loess-soil sequence and with San-I and San-II glaciations in Poland. The interglacial deposits between Dnieper and Tyligul tills are correlated with Holsteinian, and with Zavadivka unit of the loess-soil sequence. The interglacial deposits between two lower tills are correlated with Ferdinandov interglacial of Poland, Bilovezha interglacial of Belarus and with Lubny unit of the loess-soil sequence of Ukraine.

The cycle terraces are best studied in the Dniester valley – 9 Pleistocene terraces with characteristic mammal- and malacofaunas. In the Dnieper valley, the oldest terraces are buried. The Upper Pleistocene terraces are: the I-st (Vytachiv bug) and the II-nd (Kaydaky-Uday) ones. The III-rd terrace was formed after retreat of the Dnieper glacial. Alluvium of the IVth terrace, overlain by Dnieper till, is of Middle Pleistocene age (Potyagaylivka and Zavadivka). Its microtheriofauna is related to the Syngil complex, and the malacofauna, by presence of *Corbicula fluminalis*, is correlated with Old Euxinian of the Black Sea. The Gun'ky terrace of the Dnieper is correlated with the Vth terrace of the Dniester by presence of *Unio tiraspolitanus* fauna.

The Holocene, Karangatian, Old Euxinian and Chaudian marine terraces are observed along the Black Sea and Sea of Azov. The Karangatian is reliably corelated with Eemian. During cold Pleistocene units, the sea level was lower than presently, and deposits of these units are located on the shelf.

CHRONOSTRATIGRAPHY AND CLIMATIC EVOLUTION OF MIDDLE AND UPPER PLENIGLACIAL OF EAST CARPATHIANS

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Since the early 80ties, the high climatic and palaeoenvironmental potential of the pleniglacial loess sequence in Central Europe has been demonstrated. Many Upper Palaeolithic settlements providing abundant organic matter for 14C dating occur here in the loess deposits. The East Carpathians (Middle Pruth and Middle Dniester regions, rich in high quality flint) is of main importance and makes the link between the Middle Danube and the Russian Plain and between the Baltic and the Black Sea. The construction of the regional sequence is based on combination of three East Carpathian loess records: Mitoc Malu Galben (NE Romania), Cosautsi (NE Moldova) and Molodova (SW Ukraine). In the time span 50,000–10,000 BP, about 20 positive climatic oscillations marked by humiferous soils were recorded in alternation with loess and cryogenic soils and chronologically positioned on the ground of some 80 radiocarbon dates from Groningen and Oxford laboratories. This provides one of the best documented palaeoclimatic sequence for the middle and upper pleniglacial.

The middle pleniglacial is well represented in Molodova and Mitoc Malu Galben. The first part of this period, recorded in Molodova V, is related to Middle Palaeolithic occupations. It shows the development of 4 soils recording a climatic trend from rather moist to drier conditions. The second part of the middle pleniglacial is best documented in Mitoc with 5 humic soils between 34,000 and 26,000 BP together with Aurignacian and Gravettian industries in succession.

The upper pleniglacial is subdivided in two phases: the first one records deposition of the main loess between 26,000 and 20,000 BP, as well as several episodes of stabilisation under permafrost with tundra gleys and occasionnal ice-wedge pseudomorphs. Two short positive oscillations could also have been recorded during this period, around 25,500 and 23,500 BP.

The second half of the upper pleniglacial shows a remarkable development at Cosautsi with the deposition of a thick sandy loess containing almost 20 well dated Gravettian occupation layers. The beginning of this period records two sets of short interstadial phases which have been dated between 20,000 and 19,000 BP and between 18,000 and 17,500 BP. This period is characterized by intense aeolian sandy deposition between 17,000 and 16,000 BP comprising and followed by permafrost episodes. Pure loess sedimentation restarts between 14,000 and 10,000 BP; this period is characterized by development of 4 humic horizons ascribed to the Bolling and Allerod interstadials, the lower horizon being posterior to 13,660 BP.

All together the data from East Carpathians provided a firm chronological and chronostratigraphical framework for the main climatic events that occurred during the second half of the Upper Pleistocene. Such results will be used as a key for long distance correlation between the Middle Danube Basin and the Russian Plain; therefore they represent a major contribution to the understanding of the climatic history in a global change perspective.

CLIMATE–STRATIGRAPHY OF THE MIDDLE PLEISTOCENE IN THE UPPER DON DRAINAGE BASIN.

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Oxygen stages	Polarity	Million years	Horizons	Fluvial and glacial deposits		Important forms of small mammals	Fauna and flora
5		0,120 Blake	Mikulian	Shkurlat suite			WTf(M,SM)
6			Dneperian	Alluvium 3rd ter.			
				Alluvium 4th ter.			
7		0,182 Jamaica		Liski suite		*Arvicola mosbachensis*, *Arvicola chasaricus*, *Terricola gregaloides*, *Stenocranius gregalis*, *Mimomys intermedius*, *Mimomys pusillus*	
8		0,290 Levantin					
9			Likhvinian	Strelitsa suite			WTf:M-*Platyla*, *Gastrocopta*
10			Okan	Tafino suite			B,A:M-loessial
11		0,390 Biwa-III	Muchkapian	Galich(?) opt.			WT?:M
				cool			Cs:M,SM
				Konakhovka opt.			WT:M,SM-*Glys*
12			Donian	Podrudnyansky C			A:F
				Glazovo opt			WT:Ff,SM-*Glys*
		0,460 Emperor		Don suite			A
13			Ilyinian	Moiseevo suite			
14		0,580 Big Lost		Veretye suite	Upper		C:M
							WT:M-*Clausiliidae*, *Gastrocopta*, SM-*Insectivora*
15					Lower		
16		0,635 Delta		Kalach suite	Upper		A:M-loessial, F-A
17					Lower		WTs:SM-*Allactaga*, M-*Fagotia*
18			Pokrovian	Pokrovka suite			AB:M-loessial, F-B
19		0,780 Matuyama	Petropavlovian				
20				Petropavlovka suite			WT:SM
21			Port-Katon.	Ranova strata			AB:Ff

Climate and landscapes: WT – warm-temperate, B – boreal, A– arctic, C – cool, f – foerst, s – steppe;

Fauna and flora: M – molluscs, SM – small mammals, F – flora.

PALYNOSTRATIGRAPHY OF PLEISTOCENE INTERGLACIAL AND INTERSTADIAL DEPOSITS IN WESTERN LATVIA

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Western Latvia is one of the most significant stratotype areas of Middle Pleistocene deposits in Latvia, both of continental (Pulvernieki, Letiza) and marine (Akmenrags) facies. Abundant data have been collected by litho- and biostratigraphical studies of glacial and nonglacial sediments from outcrops and test drilling cores. The formation of Pleistocene cover in the coastal area of Western Latvia was strongly affected by glacial activity and sea level fluctuations. In some areas, the older deposits have been eroded or glaciodislocated that affects their stratigraphic interpretation.

Interglacial deposits with typical Holsteinian pollen spectra have been found at Pulvernieki, Jaunskieri, Oglu kalns and also studied by the author. The pollen spectra from these sites are rich in coniferous and alder pollen. Pollen of broadleaved trees is not very abundant, but climatic optima are clearly expressed, following the *Picea* and *Abies* maximum, or contemporaneous with it. *Picea* sect. *Omorica* and *Pinus* sect. *Strobus* are present in almost all sections.

In the test drillings of the Coastal Lowland in the area between Akmenrags and Jurkalne, several sites occur (Akmenrags, Strante, Ozoli, Sudrabi, Ulmale), where sediment sequences contain pollen spectra reflecting the vegetation development characteristic for the Pulvernieki (Holsteinian) Interglacial. Foraminifera and diatom data suggest marine environment during sedimentation of these deposits. This interglacial marine sequence is named the Akmenrags Formation. Pollen sequences from these sections are well correlated with those of the stratotype section at Pulvernieki. However, they have additional pollen of *Taxus, Zelkova, Ligustrum, Buxus, Hedera*, and spores of *Osmunda*.

The early appearance of *Carpinus* pollen already before the culmination of broadleved trees at the early temperate stage is characteristic for the Pulvernieki/Akmenrags Interglacial pollen diagrams. Similar character of the *Carpinus* curve has been observed also in the pollen diagrams from Lithuania and eastern Poland, whereas in pollen diagrams from Western Europe, *Carpinus* appears only at the very end of temperate stage. In many diagrams of the Butenai interglacial in Lithuania, *Carpinus* pollen culminate together with *Picea* and *Abies*. Also in the Byelorussian, Ukrainian and Russian diagrams *Carpinus* appears early and is more abundant than in diagrams from Western Europe. All above mentioned suggest the immigration of *Carpinus* from the SE in the studied area during Holsteinian Interglacial.

The end of Pulvernieki/Akmenrags interglacial is characterised by some decrease of tree pollen, whereas herb pollen increases, particularly Ericales and Cyperaceae. Among the trees, *Pinus* pollen decreases considerably, but Betula and particularly *Alnus* pollen increases in abundance. Pollen of *Quercus, Carpinus* and *Abies* also appears again, with low, but continuous curves. Subarctic flora elements, e.g. *Dryas*, occur simultaneously with broadleaved tree pollen.

The pollen spectra from sediments overlying Akmenrags interglacial deposits reflect typical open landscape vegetation and suggest cold arctic and subarctic early glacial climatic conditions. If the pollen spectra of pollen zones from Akmenrags are well correlated with those of the terrestrial Pulvernieki interglacial deposits, pollen spectra from Early Kurzeme (Saalian) glacial interstadial sediments is difficult to distinguish from Early Latvia

(Weichselian) sequences. Pollen spectra of the early Kurzeme interstadial indicate significant increase in Pinus pollen and abundance of Betula, as well as Ericales and Polypodiaceae. The poorly preserved pollen of *Picea, Carpinus, Ulmus* and *Tilia* form continuous low abundance curves, but still pollen may be redeposited.

The pollen composition from Early Latvia sediments in Grini, Plasumi, indicates two interstadials after the first stadial, without glacier advance. The interstadials are better expressed than the Early Kurzeme one. The spectra of first interstadial which probably can be correlated with Brorup in NW Europe, show that Betula is replaced by Pinus, some Picea and Larix. The opposite development trend marks the second half of this interstadial.

The second interstadial is characterized by an expansion of coniferous forest, with a dominance of *Pinus* and the presence of *Picea* and *Larix* indicating a considerable climatic amelioration during the optimum of this thermomer. At the end of the interstadial, there is a sharp decrease of *Pinus* and *Picea* pollen, and an increase of *Betula* and herbs. This interstadial correlates probably with Odderade in NW Europe.

The pollen diagrams of Felicianova (Eemian) in Grini, Plasumi, Satiki demonstrate the presence of a succession of the following trees: *Betula, Pinus, Ulmus, Corylus, Quercus, Fraxinus, Tilia, Carpinus, Picea* and *Pinus*. Pollen diagrams from the Eemian sections in Western Latvia are therefore well correlated and similar to main pollen zones which have been recorded. The differences are shown more at the earliest part of Interglacial than later, that indicates that the zone boundaries may not be strictly synchronous in the Early Eemian. The tree pollen sequence in the territory of Latvia started by predominance of birch, which gradually became replaced by dominance of pine. The maximum distribution of broadleaved forest developed by appearance of elm and oak. However, the highest values of elm appeared only after the beginning of the hornbeam peak. High values of *Tilia* are characteristic for the flora of Last Interglacial in western Latvia, represented by *Tilia cordata, T. tomentosa* and *T. platyphyllos*. The peak of Tilia pollen curve is very clear and strongly expressed in pollen diagrams of western part of Latvia.

Predominance of broadleaved trees and presence of other warm demanding plants (*Hedera, Sambucus nigra*, and *Osmunda cinnamomea, Brasenia*) in pollen diagrams of Felicianova (Eemian) Interglacial indicate warmer climate with a larger oceanic influence than during Pulvernieki/Akmenrags Interglacial. The pollen diagrams reveal the immigration and expansion of *Carpinus* during the second part of Last Interglacial, being replaced by coniferous – spruce and pine – at the end of the interglacial. In some diagrams from western Latvia marine sediments, *Abies* pollen appears in the *Picea* zone, but its amount is significantly smaller than in the diagrams of Akmenrags Formation. *Abies* pollen has not been observed in Eemian Interglacial diagrams of Latvia mainland.

The sediment units containing abundance of pre-Quaternary pollen have the least clear stratigraphical position. For instance, the pollen sequences from black clay and silt of Lazdini and Bomaisi sites which are rich in *Pinus*, broadleaved tree, *Tsuga, Podocarpus, Juglans, Taxus* pollen. Their curves fluctuate and do not show a sequence of vegetation development. In addition, the presence of *Selaginella, Juniperus* and *Ephedra* suggest redeposition of these deposits. The sediment sequence in the test drilling at Aizpute is an exception. There pollen spectra reflect interglacial vegetation development, probably of Early Middle Pleistocene age or even older, because they contain large amount of pre-Quaternary pollen, Mesozoic and Devonian spores, and Tertiary pollen. It is difficult to correlate them with spectra from others pollen diagrams in this region because the diagrams of earlier Quaternary sediment sequences are fragmentary.

CRYOGENIC FEATURES IN THE UPPER PLEISTOCENE DEPOSITS IN THE UPPER DNIEPER REACHES (SMOLENSK REGION)

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Paleocryogenic mounds were observed near the Gnezdovo village (15 km to the west of Smolensk, the right side of the Dnieper, by its tributary Svinets). These are margin features composed of till deposits: gravel, cobbles, boulders, sometimes calcareous, loams, and partly argillized sands. The size of boulders is up to 30 cm in diameter and sometimes larger. The observed thickness of deposits is more than 15 m.

Ice-wedge pseudomorphs have been also studied near the Gnezdovo village, in exposure on the western side of quarry located on the paleocryogenic mound. These are distinct wedge forms up to 1 m in depth and up to 50 cm in width located close to the surface. They are easily identified by a color: brown wedges within light brown till deposits. The peripherical parts of the features is dark-brown due to enrichment in iron oxides and hydrooxides. The boundary is gradual, but easily identifed. The upper part of wedges is bleached, and their lower part is more ferrigenous, of dark-brown color. Some of boulders within the transitional zone between ice wedge and dissected Quaternary deposits are cracked. These cryogenic features form a continuous succesion changing in their size.

In sandy-loamy deposit of the river bank, at 1 m depth, there were also observed rusty-brown ringlike ortsteins, which can be correlated by their age with wedge ice pseudomorphs.

AN IMPACT OF EARLY NEOPLEISTOCENE CLIMATIC CHANGES OF PLANT COVER OF THE STEPPE ZONE OF UKRAINE: KEY PROBLEMS

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The start of Pleistocene was characterized by both irreversible and cyclic climatic changes. Rather distinct alternation of pluvial and arid epochs in the South of Ukraine is recognized. The former were characterized by strengthening of arboreal vegetation and the latter were represented by broad spectrum of xerophytic herbaceous formations. During Early Neopleistocene, the formation of buried soil and loesses occurred in the steppe zone in the frame of the climatic megarhythm "humid – dry" rather than "warm – cold" as it was believed early. This is proved by an analysis of representatives of the Chenopodiaceae family.

For the sediments which correspond to thermoxerotic stage, the leading role belongs to the representatives of mesoxerophytic and xerohalophytic groups whereas mesophytes dominate during the second half of an interglacial.

During cryohygrophytic stages, pioneer groups and communities of psammophytes existed side by side with those of semi-saline and saline meadow soils with *Petrosimonia brachiata, Suaeda confusa, Salicornia herbaceae* etc. In the sediments which correspond to the cryoxerotic stages, xerophytes and xerohalophytes dominated which are peculiar to steppe and semi-desert/steppe coenoses. Despite the existqnce of a general tendency to climatic continentalization, the amplitudes of the main climatic oscillations were considerably less during Early Pleistocene than during next stages. The evidence of the fact is the least differentiated character of the vegetation changes. It was expressed rather in some changes of the ratios between tree species and arboreous formations than in the substitution of one species by another. This is proved by pollen analysis of 782 samples.

LACUSTRINE SEDIMENTOGENESIS IN THE TERRITORY OF UKRAINE IN PLEISTOCENE

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The development of old lacustrine basins in the territory of Ukraine was influenced by a repeated direct and indirect impact of a glacier, the conditions of sedimentation in the lacustrine basins, and by built up of the Quaternary cover. The origin of lacustrine basins, duration of lake existence and the hydrological regime of a lake were key factors of sedimentation processes. Sediments of lacustrine genesis are basically clays, loams, less often grey and dark-grey sandy loams, with larger or smaller inclusion of organic component depending on paleoclimatical conditions. The built up of lacustrine deposits indicates that the features of glasial-lacustrine and alluvial-lacustrine sedimentation are dependent on a ratio of organic substance, carbonate material and silica component. Considering the lacustrine sedimentogenesis from view-point of proportions of several mineral components in sediment composition, it is possible to divide the silicate-carbonate and silicate-ferrigenous types of accumulation with insignificant presence of organic component. The differences of these types are connected with the geochemical features of the main elements of sediment formation.

CORRELATION OF SUBAERIAL AND SUBAQUATIC SEDIMENTS OF THE MIDDLE DNIEPER AREA, THE WEST PART OF BLACK SEA COAST AND THE LOWER DANUBE

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A problem of interregional correlation of loess-soil series and their correlation with subaquatic deposits of intracontinental and litoral areas is an important one. We tried to carry out the correlation of the Middle Dnieper area sections (Vyazivok, Pivikha, Chygyryn, Gun'ki, Matviivka, Andrusivka, Stayky), the West part of Black Sea coast (Morozivka-2, Prymorske, Roksolany, Sanzheyka) and the Lower Danube (Uzmari, Nagorne 1 and 2, Plavni, Ozerne). In the studied sections, the Prychernomorsk unit (pc) is fixed only in the West part of the Black Sea coast. It is represented by brownish-pale-yellow loess, 0,3–5,4 m thick (the age 9 800 yrs), underlying by grey-light-brown soil, 0,6–1,2 m thick (the age 10 060 yrs, the Geteborg episode) and pale-yellow, grey-pale-yellow loess/loess loam, 0,2–2,5 m thick (the age 11 050 yrs). The Dofinivka unit (df) is also observed only in this region (Prymorske, Roksolany, Sanzheyka). It is represented by a grey-brown, brown, redish-brown soil, 0,8 m thick (the age 11 570 yrs) and a light-grey-brown soil, 0,6–1,4 m thick (13 700 yrs). The Bug unit (bg) is pale-yellow, light-pale-yellow, brownish-pale-yellow loam, 1,3–9,5 m thick (the age 16 170 yrs at the top, 25 070 yrs at the bottom, Lashamp episode), in the Black Sea coast, it is more thick. The Vytachiv unit (vt) is a paleosol, sometimes doubled and tripled, redish-brown (the Black Sea area), brown (the Middle Dnieper), light-grey (the Lower Danube), 0,5 2,5 m thick. The age is 30 300–36 400 yrs. The Uday unit (ud) is brownish-pale-yeloow, pale-yellow loess, loess loam, sandy loam, 1,0–1,5 m thick; in the South of Ukraine, the series increases in thickness up to 5–10 m (Ozerne, Roksolany). The age is 42 000–45 000 yrs at the top, and over 50 000 yrs in the middle part. The Pryluky unit (pl) presents single or doubled light-brown, light-brownish, brownish-grey fossil soil 1,0–2,5 m thick in the Dnieper area. In the South of Ukraine, this unit is characterized by a complex of doubled and tripled soils (sometimes with a loess interlayer) of brown, redish-brown, grey-brown color, 1,0–2,5 m thick. The top of soil has the age 100 000–110 000 yrs, the bottom of the soil is 150 000–156 000 yrs, Blake episode. In the Middle Dniepre area, the Tyasmyn unit (ts) is observed in only few sections (Chygyryn, Matviivka, Andrusivka), in the other ones it disappears from sedimentation sequence. The unit is a pale-yellow loam, 1,0–1,5 m thick. In the South of Ukraine, the unit is a pale-yellow, pale-yellow-grey loam, 0,3–2,0 m thick (the Lower Danube) and grey-yellow and pale-yellow loam, 0,2–1,8 m thick (the Black Sea area). The Kaydaky unit (kd) is a soil or doubled soil, observed almost in all studied sections. In the Dnieper area, soil represents a dark-grey, grey and brown loam, in the Lower Danube area, it is dark-grey and dark-brown loam, 0,3 to 2,5 m thick. The Dnieper unit (dn) consists of sediments of different facies. In the Middle Dnieper area, in all sections it consists of till which can be overlain by loess, loess loam, aleurite, sand with gravel, and underlain by loess, glacio-fluvial loam, sand with gravel and pebbles. In the South of Ukraine, the unit is a typical light-pale-yellow, pale-yellow loess, sometimes with thin fossil brown soil (Roksolany, Ozerne), 2,5–10.0 m thick, the age 240 000–290 000 yrs, the Dnieper paleomagnetic episode. The Zavadivka unit (zv) in the Middle Dnieper area, is a series of fossil brownish-brown, dark-brown, redish-brown soil (1,0–2,5 m), pale-yellow loess loam (0,5–1,5 m) and alluvial deposits of Ivth terrace (sands, clays, loams, gravel, 3,0–4,0 m). Subaquatic series are rich in remains of fossil fauna and

flora. In the Lower Danube, the unit is characterized by red-brown, brownish-brown, grey fossil soil (0,5–2,0 m) and thick series of estuary, alluvial and lacustrine deposits (sands, gravel, sandy loams, clays, loams) of Old Euxinian transgression, 1,0 to 12,0 m thick. From these deposits, ostracod and mollusc fauna, small mammals, spore-pollen complexes have been obtained. In the Black Sea area, the Zavadivka unit is a red-brown, reddish-brown, doubled or tripled soils 1,5–2,5 m thick. The age of soils is 340 000–390 000–440 000 yrs. Zavadivka soil (s.str.) has the paleomagnetic episode V. The Tylygul horison (tl) (Vyazivok section) is represented by a pale-yellow loess and lacustrine light-grey loam. Lower series is a pale-yellow-brown loess, 9.0 m thick. In the Middle Danube are, the unit includes deposits of upper series of Vth terrace: sands, gravels, clays and aleurites (up to 5,0 m) with rich fauna of ostracod, mollusc and small mammals. In the Black Sea area, the unit is characterized by pale-yellow, brownish-yellow, pale-yellow-light-brown loess, 1,3–2,4 m thick. The Lubny unit (lb) represents the complex of doubled and tripled soils (grey,dark-grey,brown,reddish-brown), 2,5–3,0 m thick, the Ureki episode. The Sula unit (sl) is characterized by grey-pale-yellow, pale-yellow loess, loess loam and sandy loam, 1,0–6,0 m thick. The Martonosha unit (mr) is a single or doubled dark-brown soil (Vyasivok), reddish-brown soil (the Black Sea area), 1,0–2,0 m thick. In the Lower Danube area, the lb, sl and mr units correspond to subaquatic sediments of Vth and Vth terraces.

THE TAPHONOMIC SIGNIFICANCE OF THE DONBAS MIDDLE PALAEOLITHIC SITES

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As well known, Donbass (South-Eastern Ukraine) is a part of a belt of the Quaternary loess-soil formation. The Donbas Quaternary loesses (loess-loams) and paleosol include not very numerous Palaeolithic remains.

More abandunt Palaeolithic sites are present in the border of so-called Bakhmut-Torets basin, North-West Donbass. The geological age of the Donbass Middle Palaeolithic sites has been determined by Dr. N. Gerasimenko and Prof. M. Veklich. The regional Middle Palaeolithic flint artifacts are bedded into a loess-soil deposits from the Kaydaky up to the lowermost part of the Bug units. The pecularity of the Donbass Middle Palaeolithic evidences is a very late geological dating (the Bug loess complex of the Bilokuzmynivka site) which is associated with a time of the Middle-Upper Palaeolithic transition industry or the early Upper Palaeolithic industry. As a rule, the preservation of the Middle Palaeolithic cultural remains is not very good due to a re-deposition processes during the Late Pleistocene. Only flints from the Kaydaky fossil soil of Kurdyumivka site are in a good taphonomic conditions. Other findings form conditional complexes within the lithological horizons.

There exist the next types of the Middle Palaeolithic flint artifacts in Donbass:

- accumulation of re-deposited Palaeolithic remains in depressions (Kurdyumivka – the Uday loess complex, Zvanivka);
- recurrent hill wash of the findings from one complex, which caused formation of several separate horizons of findings in different lithological layers (Antonivka, Ozeryanivka);
- accumulation of the Palaeolithic artifakts on denudational surfaces (Cherkasske);

In the 90-ies, the interesting paleontological site has been found not far from Antratsit town of the Lugansk region. There the Pleistocene animal bones were piled up in the form of vertical tape, according to the stream beds.

The special type of re-deposition of cultural remains was connected with specific secondary movements due to both cryogenec activities and soil fauna activities (Bilokuzmynivka, the Bug loess). As a consequence of this redeposition, flints moved up (mainly) and down off their primary position. The initial position of a layer has been determined by the concentration level of the biggest findings in the site profile. This type of cultural layer destruction is typical for the many Upper Palaeolithic sites of the region (Amvrosievka-camp, Visla Balka and others).

STRUCTURE OF MARGINAL LANDFORMS OF DNIEPER (ZAALE) ICE–SHEET IN BELARUS

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New evidence, which have been obtained during the last ten years, allowed to specify the structure of the Dnieper ice-sheet marginal relief. The researches were based on conjugated studying of relief and deposits and with an allowance for buried glacial valleys. Structure and correlation of landforms of the Dnieper ice-sheet are characterized in accordance with the new stratigraphic chart. Within the Belarus the marginal landforms form three large zones. The south zone of ridge-and-hilly topography (Predpolessiye and Polessiye) belongs to the maximal stage of the Dnieper glaciation, the Minsk and Oshmyany branches of the Belorussian Ridge are associated with the ice-sheet surgings of the later Minsk and Oshmyany stages. These zones of landforms have individual glacial horizons separated by only interstadial layeres.

Marginal landformes of the maximal stage have interrupted occurence. They have been strongly denudated. Originality of their morphology is determined by alternation of ridge-and-hilly chaines and the flat undulating planes. There are seven phasial complexes in morphology of this zone. Their outlines are naturally changed to the proximal direction. Within the five earlier phases ridges and hills form three great lobe sectors: West-Polessiye, Central, Upper-Sozh. The next Slavgorod and Mogilev complexes have smooth sublatitudinal outlines with numerous small tongues.

The Minsk belt of the ridge-and-hilly topography extents almost uninterruptedly across the whole Central Belarus. Three sectors are found out within the orographic system: Niemen, Berezina and Dnieper. The greatest glacial accumulations of interlobate and frontal highlands and ridges are situated here. They consist of from three to seven longitudinal series of ridges and hills of phasial rank.

North-west of the Minsk belt there are marginal fearures of the Oshmyany stage, which include Oshmyany-Dokshitsy and Voronovo-Grodno lobed arcs. Within the arcs it can be distinguished five echelon-like complexes of ridges and hills, which have appeared due to ice-sheet phasial readvances.

Push ridges and hills prevail in structure of all stadial zones. They consist of morainic and fluvioglacial deposits, have imbricated and fold structure, numerous erratic masses. Along the low parts of ridges the push socle is overlain by intrafluvioglacial deposits. The fluvioglacial cones and outwash plains usually form the southern slopes and foots of marginal landforms.

Thus, the marginal landforms within the area of central and southern Belarus have been formed as a result of the recession phase and Minsk and Oshmyany stadial readvances of the Dnieper glaciation.

PLEISTOCENE CLIMATE DYNAMICS IN UKRAINE.

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Investigation and analysis of climate variations are necessary to get to know the behaviuor of climate dynamics and its interpolation in time.

The collected pleistocene facts allow to obtaine necessary series of paleoindexes and to make the analysis of their fluctuations.

On the first stage collected data from different sources were used. Then, four independed series of paleoindexes obtained with different methods were selected.

On the second stage following problems were analysed:

1) continuity of the paleondexes series;
2) territorial data distribution;
3) heterogeneity of the series of paleotemperature;
4) systematization of the actual data.

On the third stage only average annual series of paleotemperature were analysed with the help of the methods of mathematical statistics.

Variations of the average annual paleotemperature in time were present in the form of a sum of harmonic oscillations. Least square method was applied for the estimation of the series coefficients.

Analysis of our results shows that the coefficients are significant, and an instability of determination of some of them is caused by insufficient degree of the approximation.

Future investigations in the field of mathematical data processing of independ series of paleoindexes will allow to construct a mathematical model of temperature variations.

TWO ICE–SHEET LOBES OF THE MIDDLE VISTULIAN GLACIATION IN THE NORTH–EAST POLAND

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The glacial sediments of the Middle Vistulian Glaciation are known from North Europe (Ireland, Scotland, Norway, Sweden, Finland, Danmark, North-West Russia, North Poland) (Mojski, 1993).

The most recent geological investigations (carthography and borehole data analysis), petrographical studies and TL datings of the youngest tills in the North-East Poland indicate that there were two advances in the youngest ice-sheet (Vistulian Glaciation). The first of them happened in the Middle Stadial, called "Świecie Stadial" in Poland (74–59 ka BP), the second – in the Main Stadial (23–18 ka BP).

The centre of glaciation in the Swiecie Stadial was located in the eastern part of Scandinavia (West Finland, Aland Islands) (Gałązka et al., 1998).

In the North-East Poland, the Swiecie Stadial ice sheet covered the northern part of Kurpie Plain as far as Kolno, Wasosz and Klimaszewnica, slipped a small ice tongue into the Biebrza River valley, reached the front of Sokolka Heigts in the vicinity of Dąbrowa Białostocka, and slipped an ice tongue into the Nurka River valley. In Belarus, the ice-sheet evaded the Hrodna Upland slipping an ice tongue into the Nemunas river valley as far as Hrodna. It also reached the valley east of Hrodna, covering it with a large ice lobe as far as the Świsłocz River Mouths and Dubrowlany. From there, the eastern edge of the ice lobe ran towards Skidel, Ostryna and Motyle towards the present Belarus/Lithuania border.

The major feature that allows to distinguish different age tills is petrographical composition of gravels. The paper shows a comparison of petrographical composition of gravel of the uppermost till horizons from the North-East Poland. It allows to set their stratigraphical position.

Metodologhy of petrographical studies was characterized shortly by Lisicki (1998). Samples must contain at least 100 grains, 5–10 mm in diameter. The analysis procedure included the calculation of percentage contribution of particular groups of Scandinavian rocks (crystalline rocks, limestones, marls, sandstones, quartzites and quartz grain) and local rocks (limestones, dolomites, marls, sandstones, siltstones and claystones). Proportion between different rocks in each sample are characterized by petrographic coefficients: O/K, K/W and A/B (K= total of cristaline rock and quartz, O= total of sedimentary rocks, W= total of carbonate rocks, A= total of rock no-resistant to destruction, B= total of resistant rocks).

Among the youngest tills there are 5 lithotypes: B2, B1, B1 bis, W2 and W1. The average petrographical coefficients of the tills of lithotype B1 (21 samples) are: O/K=1,92, K/W=0,55, A/B=1,71, and for tills of lithotype B1 bis (13 samples) are: O/K= 1,38, K/W=0,81, A/B= 1,10.

Tills ***B1*** and ***B1 bis*** can be correlated with the older stadial of the Vistulian glaciation (Schalkholz, **Świecie Stadial**, Varduva, Nemunas 2a, Dvinskij subhorizon, Miezhinskij stadial). They occur to the north of the Leszno Phase, as well as to the south. Their occurence is regionaly diverse (***B1* in the west**, ***B1 bis* in the east**) with the separating line running north-south from Suwalki and Augustow. It is very probable that the tills, so petrographicly diverse, were deposited by two different ice-sheet lobes moving along on various rocks. In the case of the lithotype B1 it was probably a lobe from the north (the Mazurian lobe), whereas in the case of the lithotype B1 bis the lobe came from the north-east (Vilnius, Lithuanian or Suwalki lobe).

PLEISTOCENE DUST STORMS IN CENTRAL AND EASTERN EUROPE

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Early glacial climates in Europe were interrupted several times by major dust storms which deposited thin layers of eolian dust called Markers and in many locations terminated temporarily the development of biogenic soils. Markers were first described in Bohemia and Moravia. There they appear in the Early Glacial pedocomplexes PK II and PK III. (Kukla and Lozek 1961). The easternmost site of a Marker is in Vyazyvok, Ukraine, the westernmost in Achenheim in France. At the latter site a few centimeters thin sharply delimited layer of fine grained eolian silt with a TL minimum age of 64.9 +/- 6.9 ka separates autochtonous soils from hillwash sediments. The PK II and PK III soils were earlier correlated with the marine oxygen isotope stage MIS 5. The sharply delimited base, the marked difference of lithologic composition, and the lack of bioturbation, contrasting with intensely reworked chernozem at the base, resemble a layer of volcanic ash. Magnetic susceptibility of the layers is low and contrasts with surrounding soils. Markers are commonly calcareous. They were interpreted as deposits of continental-scale dust storms. They were described from numerous sites in their type area in the Czech Republic, Slovakia and Austria, but apart of France and Ukraine were also identified in Germany and Moldavia Three Markers occur in the pedocomplex correlated with MIS 5 and two each are known from the PK IV (MIS 7) and PKV (MIS 9) in Moravia.

Markers are overlain by hillwash sediments composed of fragments of reworked older loess. In the type area of Markers, these deposits are called Pellet Sands. They contain resedimented blackish humous chernozem fragments in the lower part and reddish-brown grains of reworked interglacial Bt horizon in the upper part. The known thickness of the pellet sand layer varies from a few decimeters to several meters. The transition into the overlaying loess is gradual.

The soil sequences underlying the Markers allow a relatively accurate reconstruction of the environment from a continental, seasonally dry loess steppe into an uniformly humid forest and later seasonally dry grasslands with rich worm and rodent fauna. Either a single major dust storm or an episode of several such storms terminated the soil formation and was succeeded in turn by an interval of torrential rains which eroded the parched ground almost stripped of vegetation. The loess steppes and semideserts formed afterwards.

Thermoluminescence datings of Markers yielded minimum ages of over 50 thousands years. The estimated duration of the development of the intervening soils suggests that the Marker of PKI in Central Europe is around 105 to 110, 000 years old. It probably correlates with the Melisey I silt in Grande Pile in France (Kukla *et al.* 1997) and with the dust spike of the approximately same age in the Greenland and Vostok ice cores (GRIP members 1993, Petit *et al.* 1990). Similarly the lower Marker of PKII is about 90 millennia old and probably correlates with Melisey II. The upper Marker of PKII is correlated with the vicinity of the MIS 4/5 boundary, some 70 to 75,000 years old. This level in Central Europe coincides with the onset of Pleniglacial sedimentation which replaced the pedogenesis dominant in Early Glacial.

The explanation of the abrupt termination of pedogenesis over much of Central Europe accompanied at many sites by apparent extermination of local soil faunas is more difficult. The rapid onset of the storms and the related major shift of local environments points to a sudden rearrangement of atmospheric circulation and precipitation regime in the northern

middle latitudes. We propose that the shift was contemporaneous with the sudden increase of iceberg calving and expansion of sea ice in North Atlantic (Bond et al 1992).

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PALEOLANDSCAPES OF COLD STAGES OF MIDDLE AND LATE PLEISTOCENE IN UKRAINE

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Reconstruction of landscapes was carried out by a complex of methods. The analysis of ecological – geographical settings of malacofaunistic complexes of the Pleistocene loess-soi series was carried out. The cold stages are represented by an arctic – boreal – alpine complex (*C.columella* fauna, V. Lozek, 1964) which consists of inhabitants of tundra, tundra – steppe and cold steppe. The other coeval faunas representatives are steppe xerophilos, wood mezo- and psylophilos, inhabitants of wood and open (steppe and meadow) coenoses, cold water stagnophilos and widespread species. On the base of study of malacofauna as a sensitive environmental indicator, the maps of original periglacial landscapes of the cold stages were elaborated.

The landscape zonality of the Dnieper cold stage of Mid Pleistocene is well expressed. Outside the boundaries of the glaciated area, cold open landscapes were spread. According to the klimatogram data, the average temperatures of the warmest month range from 8–12°C up to 14°C in southern regions. During a stationary position of the glacial, along its western edges there was a rather narrow (40–70 km) band with a preglacial tundra – a peculiar type of a landscape with elements of tundra vegetation and molusks presently living in tundra and subalpine belt of mountains.

The extensive plains of the Volyn – Podillya and Middle Dnieper area were occupied with a complex type of landscapes – a 'loess tundra-forest-steppe'. Tundra and boreal elements of fauna and flora were better expressed in the western and central humid regions than in dryier eastern regions. The temperature and precipitation contrasts in a system 'valley – slope – watershed' caused a high-altitude differentiation, which is traced by a change of specific fauna components. The bottoms of valleys were occupied by tundra and meadow complexes, the slopes were covered by cold-resistant bushes and sparse woods. Plateau and elevated terraces were occupied by the most widespread tundra-steppe landscapes. To the south of 48° N, the landscapes of cold loess steppe were more uniform.

During the next Valdai glacial epoch, the glacial cover was located to the north of the boundaries of Ukraine. Three cryostages are traced. In the coldest Bug stage in the northern part, up to the line Sarny – Pereyaslav-Khmel'nitsky – Sumy, the tundra-steppe landscapes were developed. To the south, up to Dnieperpetrovsk, the extensive plains were occupied by loess tundra-steppe. Landscapes of moderately cold loess steppe, up to xerotic steppe, were spread even in the south. During theWurm glacial epoch on territory of Ukraine, J. Budel (1951) determines such climatic zones (from north-west to south-east): loess tundra, loess forest-steppe, up to latitude of Kyiv, the rest of the territory – loess steppe.

The most deep landscape changes in the cold stages occurred in area of the modern forest-steppe, in which, due to the contact of heterogeneous elements, the landscapes of a heterogeneous structure were formed. In spatial distributionof periglacial landscapes, despite of the obverved similarity of the environmental conditions, there existed zonal – geographical and provincial differences.

LATE GLACIAL AND HOLOCENE PALEOENVIRONMENTS OF SOUTHWESTERN CRIMEA: INITIAL SOIL AND POLLEN DATA

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Recent collaborative, interdisciplinary research in southwestern Crimean is yielding a detailed, radiocarbon-dated, paleoenvironmental record for the Late Glacial and Holocene. This paper presents three key research locales:

1) A 2.8m core in alluvial sediments of the Chernaya River spanning the last 6200 years, preserving distinct sediment packages, soils, and pollen;

2) A 5.2m exposure in gully fill with a detailed sequence of Late Glacial-Holocene sediments, pollen, and soils;

3) A 2.4m gully fill preserving a record of intercalated pollen, sediments, and soils that reflect variations in vegetation and soil forming regimes from around 7000 bp to the present.

Comparison with other locales in the southwestern Crimea indicates that these locales are representative of the regional pattern, and comparison with patterns from southern Ukraine also show broad similarities.

'WRONG' INTERGLACIAL AND INTERGLACIAL ERRATICS AS TROUBLE-SOME HERITAGE IN TILL STRATIGRAPHY

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Northern part of East Baltic, including Estonia, is situated in zone of alternation of glacial exaration and accumulation. As a result, most of interglacial deposits have been destroyed. No more than 8 of the Eemian and Holsteinian findings all together are known in Estonia (Liivrand, 1991). Of these only the Eemian layers at the Prangli and Peedu sites occur in a primary position. In Lithuania, situated mainly within the accumulation zone, about 40 exellent primary Eemian and Holsteinian findings are known (Kondratiene, 1996).

The secondary (or erratic) interglacial layers, being risen upwards glaciotectonically, may be erroneously taken as younger ones, whereas the related tills as older ones than they actually are. Such a case occurred at the Karukula and Rongu sites in S Estonia. There the erratic interglacial deposits in the farmer's wells, located close to the surface, have been already discovered at the first half of last century and repeatedly used in the till stratigraphy. The connected mistakes have deeply penetrated into practice up to the present. The wrong Middle Weichselian Karukula Interglacial, being placed between the Late Glacial reddish brown till and the underlying violetish gray tills, showed the latter as a thick Early Weichselian Valgjarv till (Raukas & Kajak 1995). The erratic Eemian deposits at the Rongu, being locally covered by only reddish brown Late Glacial till, do not determine neither total nor successive order of the Weichselian units. Despite a doubtful stratigraphic value of these erratics as markers, the Middle Pleistocene age has been assigned to the underlying tills, which are correlated to the Lithuanian ones. Between the latter, Snaigupele interglacial unit exists (Kondratiene, 1996). However, the palynostratigraphical value of this unit based on two sites only, is questionable because of the obvious local features. In West Europe, the Saalian Glacial was not interrupted by any interglacial. Successive order of the major geological events – Holsteinian – Saalian – Eemian – Weichselian – has been proved. After determination of the number of the interglacials, it is possible to use the redeposited interglacial pollen in the till stratigraphy.

The autochthonous marine Eemian sequence on the Prangli Island, in the Gulf of Finland, enables a clear stratigraphical separation of the Middle and Upper Pleistocene tills and related periglacial deposits. Unfortunately, the lithological composition of the tills, depending greatly on local bedrock composition, has not allowed a direct correlation of the N and S Estonian tills yet. Therefore, the autochthonous alluvial Eemian layers at the Peedu site, the described Eemian erratics in the other sites in S Estonia, the redeposited interglacial pollen in the tills and related periglacial deposits in many sites have been used to complete the marine Prangli type site. The record of the Upper Pleistocene events has been proved in Estonia. After the Eemian, the long-lasted Early Weichselian periglacial period followed, being separated from the Middle Weichselian by a short glacial advance. The main Weichselian glacial deposited the thick violetish gray Valgjarv till, and the Late Glacial - the reddish brown Vortsjarv till. The Late Glacial Kammeri Interstadial existed between them.

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PEDOGENIC MODIFICATION DOMINANTLY INFLUENCE ON MAGNETIC PROPERTIES OF SIBERIAN AND ALASKAN LOESS

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The use of magnetic susceptibility as a tool for tracking paleoclimate is now firmly established. The most striking example is provided by Chinese Loess Plateau, where warm, moist interglacial periods (and summer) developed magnetically enhanced paleosols intercalated with layers of less magnetic wind-blown loess, which accumulated during cold, dry glacial periods (and winter). However, observations in Siberia and Alaska yield an opposite sign of the relationship, magnetic maxima occurring in glacial loess layers alternating with minima in interglacial paleosols.

How these two opposite models might be harmonically explained? By looking at broader picture, the relationship between these two opposite models has been suggested that proximal sites are likely to manifest Alaskan/Siberian-type magnetoclimatological patterns. But beyond a few hundred kilometres, however, distal sites will be dominated by Chinese-type of patters.

Such wind-blown hypothesis seems having successfully explained tow opposite relationships harmonically, but is not supported by our data of magnetic investigation. Like Alaskan loess, different magnetic mineralogy was also detected between loess (magnetite/maghemite) and well-developed soil (greigite) in Siberia. This result is difficult to be harmonically explained by wind-intensity model alone as various wind-intensities can lead different magnetic input but cannot cause difference in magnetic mineralogy. Various magnetic minerals in loess and well-developed soil in Alaska and Siberia supports pedogenic modifying model. That were due to too wet condition during interglacial periods leading topsoil in reducing environment that magnetite/maghemite is finally converted to iron sulphide greigite.

In fact these positive and negative relations shown by Chinese loess and Alaskan/Siberian loess are the two end extreme points of one relationship. Recent magnetic susceptibility curves from New Zealand, from Argentina and from Pakistan demonstrated a weak/even no correlation between the magnetism and paleoclimate/pedogenesis.

Magnetic susceptibility itself doesn't have an instinct linkage to climate but might link to ferrimagnetic mineralogy variation under certain redox pedogenic environments. Magnetic susceptibility has variable behaviour corresponding to different temperature-moisture environments. In general three types of relationship between magnetic susceptibility and pedogenesis/climate can be divided as positive, negative and no clear relations. Their corresponding pedogenesis/climate ranges can be summarised as following. Ferrimagnetic minerals are produced (positive correlation) under pedogenic conditions resulting from low precipitation and high evaporation but will be destroyed (negative correlation) under high moisture (waterlogged) pedogenic conditions. If pedogenic development occurs under conditions oscillating between ferrimagnetic formation and destruction then it may be difficult to find a clear correlation between them. Therefore great care should be taken when using susceptibility values for palaeoclimatic reconstruction.

FINAL STAGES OF LOESS SEDIMENTATION IN SOUTH–WESTERN PART OF RUSSIA

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Loess mantles in the South-West of Russia occur as "loess islands" (after V. V. Dokuchaev), surrounded by fluvioglacial lowlands and river valleys. The surface of high flat interfluves was influenced by periglacial processes resulted in a patterned ground. A system of rounded depressions 20–30 m in diameter and up to 1 m deep form a regular network and occupy up to 30% of the surface. They are the remains of a former thermokarst relief. Microrelief has determined the structure of soil cover that is quite different from the soils of adjacent territories. The study of loess strata within the profile of surface soils (Greyzems and Northern varieties of Chernozems – Mollisols) allows to reconstruct the process of sequential accumulation of loess strata (approximately 3 m from the surface) during the final stages of loess sedimentation.

On the main surfaces between depressions loess strata is rather uniform and not striped. Free carbonates occur at a depth of 80–120 cm in the form of grains of loess fraction, pseudomicellia and hard nodules of hydromorphic origin. On the slopes of depressions carbonate layer abruptly deepens and never present within depressions. Along the slopes loess strata is becoming striped. Brown and bleached stripes several cm thick, first slightly visible, are gradually becoming more distinct (darker and more dense) closer to the center of depressions. The stripes had been produced by slope processes, that accompanied sequential accumulation of loess. The intensity of striping differs within the loess strata, indicating different ratio between the intensity of loess accumulation and slope processes. Maximum striping occur at a depth of 140 cm. Loess accumulation within depressions was also accompanied by intensive cryogenic processes. Due to this stripes are complicated by faults, resulted from slope movement in a frozen state (cryosolifluction) and frost cracks and pseudomorphs as a result of deep seasonal freezing and/or permafrost. Dirty hue in the color of brown stripes along with enrichment in humus content, indicate the formation of primitive (cryosynlithogenic) soil horizons during brief brakes in loess accumulation. In the upward direction striping becomes less visible, showing, that solifluction slowed down. Longer brakes in sedimentation are marked by black humus layers (so called second humus horizons) in the soils of depressions.. These layers of 30–70 cm thick are situated below humus horizon of surface soils. They are humus horizons of frost meadow soils. They sharply wedge out closer to inter-depression surfaces. Upper 50 cm of loess strata within depressions does not allow to reconstruct the process of loess sedimentation due to intensive humus color of modern humus horizon and bioturbation.

QUATERNARY GEOLOGY OF DNEPROPETROVSK REGION

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As to the structural-tectonic framework, the Dniepropetrovsk region is located at the boundaries of the Middle Prydnieprovsk block of the Ukrainian shield (USh), the western part of the Dnieper-Donetsk depression (DDD) and the northern part of the Prychernomorsk depression (PD). Combination of these large structural units caused a complexity of the regional geological built up. The intensive accumualtion within DDD and PD from Devonian to the Holocene is a direct reflection of tectonic downthrown of these structures. At the same time, the USh territory was permanently uplifted, which caused almost complete absence of sedimentary cover and presence of numerous exposures of Precambrian crystalline rocks. After the last marine transgression, the Middle Sarmatian carbonate-terrigenous deposits were accumulated within the Middle Dnieper area. The Late Miocene-Early Pliocene peneplan was formed on the surface of the Sarmathian deposits and on the surface of Precambrian rocks. The later neotectonic processes finally influenced distribution of denudation or accumulation, formation of a cover of subaerial and subaqual deposits, their thickness, layout of the modern erosional network.

The Dniepropetrovsk sequence of Quaternary deposits is one of the most complete in Ukraine. This is connected both with the structural position of the area and with position of the boundary of periglacial and extraglacial zones just within the Dniepropetrovsk area. The regular rhythmic alternation of loess units (cold stages) with soil units (warm stages) is observed. At the base of the subaerial sequance, Siversky and Beregovsky climatoliths of the Upper Pliocene are located and can be observed in the sections of a high plateau. At the lower hypsometrical levels, the sequence starts with Berezan loess unit, often with features of hydromorphism, or with its subaqual facies – the lake clays at the top of the Xth terrace of the Dnieper and the Samara river. Above the Berezan' unit, there is a set of loess and paleosol units of Eopleistocene and Neopleistocene, rather typical for the extraglacial zone but often with a much larger thickness (up to 65 m in total). The Upper Quatenary deposits are characterized by a large diversity of genetic types. In the flood-plain of the Samara, Volchaja and Tersa rivers, besides subaerial deposits, alluvial and lacustrine deposits are spread. Fossil fauna and Paleolithis sites have been described for many Quaternary sections of the Middle Dnieper area, as well as the Quaternary units stratotypes. The sections of Sadzhavka gully near v.Stari Kodaky, the Spaske, Taromske, Gavrilovka, Ivanovka, Gubinicha sections are well known. The unique section of Quaternary deposits Ribalski quarry is under investigation now.

LIKHVIN INTERGLACIAL SMALL MAMMAL FAUNAS FROM THE RUSSIAN PLAIN

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The most significant Middle Pleistocene warming is the Likhvin Interglacial, which is correlated with the Holstein Interglacial of western Europe. The Likhvin Interglacial warming was reflected in deposits of The Russian Plain as the Inzhavino fossil soil, alluvium of forth terraces of main Eastern European rivers, and the Early Eucsinian marine deposits of Black Sea (Velichko et al., 1984; Chepalyga et al., 1989; Markova & Mikhailesku, 1992). Likhvin faunas have been described from various parts of the Russian Plain, including the Don, Dnieper, Danube, and Kama rivers drainage basins. The northernmost localities have been found at ~ 57°N and the southernmost ones on the Black Sea coast (~ 45°N) (Agadjanian, Glushankova, 1986; Markova, 1982, 1990, 1996, Rekovets, 1992).

The appearance of the rootless voles *Arvicola (A. cantianus)*, which is the descendant of Mimomys savini, is the most significant event in small mammal composition of the Likhvin faunas. The rhizodont voles of *Mimomys* and *Pliomys genus* were not found on the Russian Plain in the Likhvin sediments. The steppe lemming (*Lagurus*) morphology shows on the some prevalence of "*transiens*" morphotypes above "*lagurus*" ones. The several *Microtus* species were described from these faunas, including *M. arvalis, M. oeconomus, M. gregalis, and M. agrestis. Terricola arvalidens and M. (Stenocranius) gregaloides* are absent in the localities of this age. The cold-adapted mammals were not found in the Likhvin faunas (Markova, 1982). The faunas of such species composition have been named as Gunki small mammal assemblage, after the name of complex studied stratotype locality near Gunki village (the Middle Dnieper drainage basin) (Markova, 1990). This assemblage is synchronous to Singilian Mammalian Age of large mammals (Alexeeva, 1977). In West Europe the faunas this evolutional level were recovered in the deposits of Holstein Interglacial (Heinrich, 1990; Koenigswald, Tobien, 1990; Kolfschoten, 1990).

The species composition of the Likhvin mammal faunas allows us to distinguish the main features of mammal assemblages and biomes of Russian Plain and indicates the existence of zonality of the landscape. The position of all reconstructed biomes was sub-latitudinal. The small mammal assemblage of mixed and broadleaved forests was located between ~60–50°N and included the big amount of forest species, several meadow and intrazonal mammals: *Desmana cf. moschata, Soricidae, Sciurus cf. vulgaris, Trogontherii cf. cuiveri, Castor fiber, Apodemus flavicollis, A. sylvaticus, Clethrionomys glareolus, Arvicola cantianus, Microtus (Microtus) Af. arvalis, Microtus (Microtus) ex gr. agrestis, Microtus (Pallasiinus) oeconomus*. The forest biome can be reconstructed for this territory. The forest-steppe assemblage of small mammals was placed southward from the previous one. High diversity of mammas was reconstructed for this assemblage with many steppe species /*Ochotona pusilla, Spermophilus, Marmota bobac, Allactaga major, Spalax microphtalmus, Cricetus cricetus, Cricetulus migratorius, Lagurus transiens, Eolagurus luteus volgensis, Microtus (Stenocranius) gregalis*)/, some forest mammals /(*Clethrionomys glareolus, Microtus (Microtus) agrestis*), and intrazonal species /*Desmana, Sorex, Lepus europaeus, Arvicola cantianus, Clethrionomys glareolus, Microtus (Microtus) cf. arvalis, Microtus (Microtus) agrestis, Microtus (Pallasiinus) oeconomus*/. The south limit of this biome was extended to the Black Sea coast in the western part of the Russian Plain, and was shifted to the northward in the eastern part of plain. Few small mammal Likhvin localities have been

recovered on the southernmost territories of the Russian Plain. The existence of the steppe assemblage of small mammals with *Spermophilus, Allactaga major, Pygeretmus pumilio, Sicista subtilis, Nannospalax leucodon, Ellobius talpinus, Cricetus cricetus, Arvicola cantianus, Eolagurus luteus volgensis, Lagurus transiens, Microtus socialis, Microtus obscurus* can be reconstructed by these data.

THE UPPER AND MIDDLE PLEISTOCENE LOESS–PLAEOSOL SEQUENCES IN RUMA SECTION (VOJVODINA, YUGOSLAVIA)

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The Ruma loess section is a 20 m thick sequence of alternating loess and paleosols located in the central part of the south slope of the Fruska Gora mountains, in Vojvodina region, Yugoslavia. Results of amino acid racemization geochronology suggest late- and middle-Pleistocene ages for Ruma's loess-paleosol units, which can be correlated with aminostratigraphic subdivisions in Hungary, Czech and Slovak localities. Five fossil soils represent environmental transitions from humid forest to relatively dry steppe landscapes. Especially interesting are pedogenic horizons that formed during the last glacial cycle and are found in characteristic paleo-depressions. The grain-size record of the Ruma loess-paleosol units closely coincide with various proxy records from marine sediment cores and central European and Chinese loess records. Land snail assemblages indicate relatively dry and warm conditions. The most important paleontological find is the discovery of five middle Pleistocene bear skeletons (*Ursus* sp.) from the forth loess layer.

Key words: AAR chronology, grain size, Pleistocene, land snails, loess-paleosol sequences, Ruma section and Yugoslavia.

STRATIGRAPHY OF SAALIAN IN EASTERN POLAND AND WESTERN BELARUS

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The bed of the Saalian sequence in eastern Poland and western Belarus is well defined in most cases. Tills of this glaciation are commonly underlain by the Late Elsterian glaciolacustrine series and the Holstein fluvial and lake sediments. The Saalian sequence is capped by the Eemian lake and fluvial sediments, and in the northern part of the area also by tills of the Weichselian Glaciation.

The Saalian Glaciation in eastern Poland is represented by a single till in the south and two tills to the north of Biala Podlaska. The first Saalian ice sheet of the Odranian Glaciation reached the Lublin Upland. New light has been brought up lately on a stratigraphic setting of this unit in Poland, suggesting a less extensive ice sheet limit than during the younger Saalian i.e. the Warta Glaciation, but there is still no convincing evidence to support such opinion. The ice sheet limit during the Warta Glaciation was determined on the basis of geomorphologic and geologic evidence, and the resulting pattern has been a subject of numerous controversies. The proglacial meltwaters used a valley system in the Krzna drainage basin, running eastwards i.e. towards the Prypiat River in the Polesie Lowland.

In western Belarus, there are two tills of the Saalian. They are connected with the Dnieper (older) and Sozh (younger) glacial advances of the Prypiat Glaciation, and are separated by thick glaciolacustrine and glaciofluvial series. According to recent geological and geomorphological data, the ice sheet of the Dnieper Stage extended further to the south than that of the Sozh Stage. The Saalian end moraines in western Belarus were reworked by glacial meltwaters what in turn complicates and sometimes even makes tracing a glacial limit impossible. It allows therefore different suppositions concerning correlation of the Saalian ice sheet limits in eastern Poland and western Belarus. The maximum limit of the Sozh Stage is estimated commonly slightly southwards from the Upper Narew River valley, in accordance with the exposed marginal complexes. On the other hand there are certain geological features of two Saalian advances, which were preserved, despite intensive washout processes more to the south i.e. between Vysokoye and Kamenets. In this very area, two tills or their residua overlie the Holsteinian lake deposits revealed in some interglacial profiles. These two glacial beds correspond stratigraphically and spatially well with two Saalian tills recognized in the neighbouring areas of Poland.

End moraines of the Warta Glaciation form several latitudinal zones, however with lobe-like curving to the north close to the Polish-Belarussian border. Varied ice sheet extent of the Warta Glaciation in eastern Poland and western Belarus could result from occurrence of a main intralobal zone in this part of central Europe i.e. between the Vistula and the Neman glacial lobes. Geological features prove that the ice divide between these two lobes could be affected by Vysokoye and Kamenets bedrock elevations at 80–100 m a.s.l. where the ice margin split additionally into several secondary tongues.

The maximum ice sheet limit of the Saalian was presumably metachronous. Age of the ice sheet limit during the Warta Glaciation is commonly estimated to 130–160 ka, although comparison with oxygen isotope stages in deep-sea sediments would suggest an older age of about 180 ka.

THE MIDDLE AND LATE PLEISTOCENE PALEOSOLS OF UKRAINE

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Rhythmic alternation of warm stages of soil formation and cold stages of loess formation is one of the principal regularities of the Pleistocene environmental development. The interglacial warm stages were recorded by soil suites or individual soils, as well as by alluvium. The glacial cold stages were recorded by tills, glacio-fluvial deposits, loesses and alluvium. The warm stages (Martonosha, Lubny, Zavadivka, Kaydaky, Pryluky, Vytachiv, Dofinivka, Holocene) are represented by suites of 1–5 soils, more often of 1–2 soils. Initial, optimum and final phases of the soil formation reflect a change of climatic conditions from cold and dry during the initial phase, humid and warm during the optimum, to more continental and arid at the end of the stage. The soils change according to the geographic zonality. Genesis, soil suites structure and changes of soils in time and space are shown in the Regional scheme of the palaeogeographical stages of the Pliocene and Pleistocene of Ukraine (Veklytch, Sirenko, Turlo, Melnychuk, Matviishyna, Gerasymenko *et al.*, 1993), in monographs and papers of the Ukrainian palaeogeographical team by M. F. Veklytch. Soil processes changed evolutionary, zonally and regionally.

The change of the pedogenic processes during warm stages: from subtropical (or similar to them) during the Early Pleistocene (formation of red- and brownish-cinnamonic soils, red-brown soils) to temperate-warm, temperate conditions during the Mid Pleistocene (formation of brown, grey forest soils, chernozem-like, chernozem, cinnamonic-grey and greyish-cinnamonic soils of more humid variants than the recent ones) is one of the trends of the Pleistocene soils development. The Late Pleistocene pedogenesis shows the trend to increase of climatic continentality and aridity (formation of common and southern chernozems, chestnut, reddish- and greyish-brown soils in the south of Ukraine). Chernozems in the territory of Ukraine appeared during the Lubny time. Only during the late Pleistocene, soil zonality bevame similar to the recent one (but not completely analogous). None of the Pleistocene soils suites dublicates another suite as for a suite structure and soil types. Even the soils of the Middle and Late Pleistocene, regarded to be most similar to the recent soil types, still show specifical pedogenetic features. The Vytachiv soils are the most special and have no analogues in the present soil cover of Ukraine.

Soil formation was intensive during the warm stages but it also did not stop during the cold stages, if to consider a loess as a particular soil formed under accumulative processes prevailing over the pedogenetic ones. Initial soils of a tundra genesis (from 1 to 5) are often observed in loesses and in deposits of cold stages. A trend to continentalization and aridization from the Early to Late Pleistocene is also recognized for the cold stages (the most typical "loessic" features are charcteristic for the Bug deposits, but not for the Lower Pleistocene loesses).

SEDIMENTOLOGICAL BACKGROUND FOR STRATIFICATION AND CORRELATION OF THE MIDDLE PLEISTOCENE – HOLOCENE STRATUM OF THE MIDDLE DNIEPER AREA

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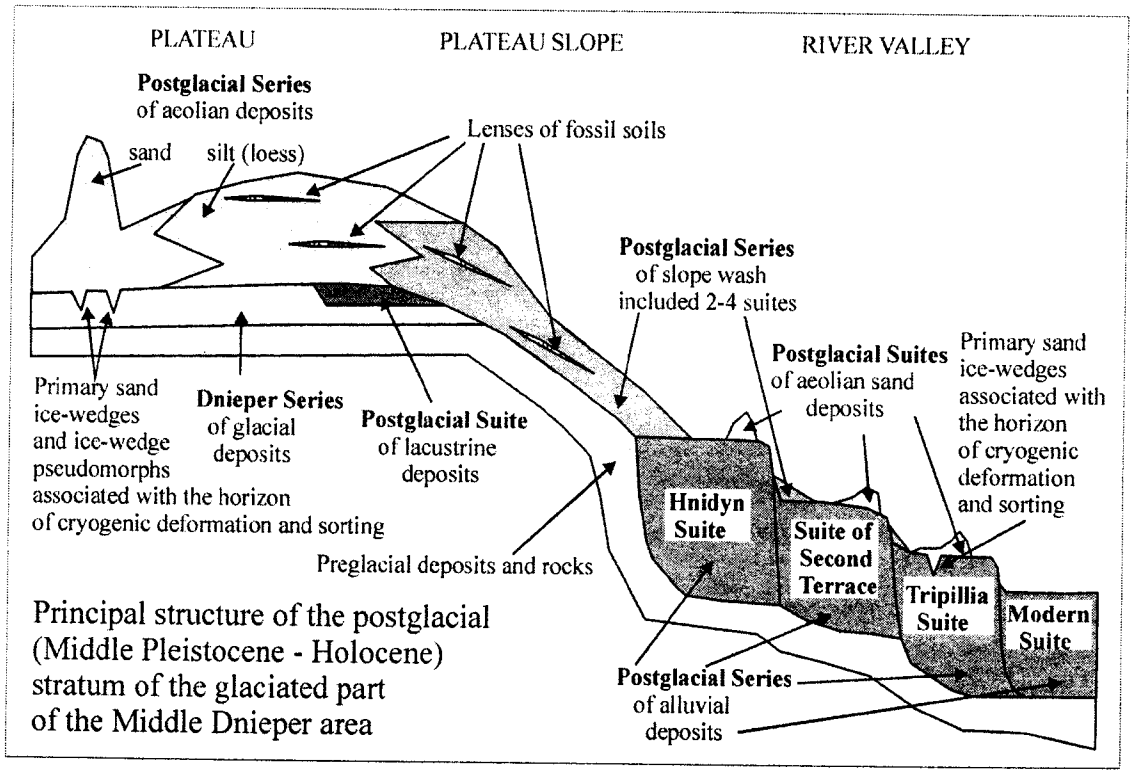
The Middle Dnieper area is one of the best investigated regions in the world as to its geology, including Quaternary and especially the upper part of the Middle Pleistocene-Holocene stratum. Within the glaciated part of the area, this stratum is positioned between the regional stratigraphic marker beds – Dnieper Series of glacial deposits and the modern surface. Several series and suites are distinguished in this stratum by means of the sedimentological and geomorphological analyses. They occur in a typical form along a strike and in a section accordingly to the main elements of relief.

The term "suite" is used for the geological body of the definite mode of accumulation reflecting an elementary sedimentation rhythm. There are no regional breaks within its boundaries. The suites can be subdivided into dynamic lithofacies with their characteristic peculiarities of the sedimentation. The interrelated suites of common origin and similar age are combined in series.



Principal structure of the postglacial (Middle Pleistocene - Holocene) stratum of the glaciated part of the Middle Dnieper area

Four main types of continental sedimentation (lacustrine, alluvial, aeolian and slope wash) had different significance in the area by their expression, velocity and duration. With exception of lacustrine sedimentation, all other types were characteristic for the postglacial time. The climatic changes are expressed in composition of facies, as well as in syn- and diagenetic transformations of sediments (cryogenic structures, pedogenic aggregates, horizons of fossil soils, secondary carbonates, etc.). As compared to the uniform loess accumulation, slope wash and alluvial sedimentation occurred rhythmically, alternating with

epochs of predominant erosion. Presumably these rhythms were stimulated by pulsating tectonic uplift of the area.

Any stratification and correlation could not be effective and reliable without taking into consideration a suite structure and peculiarities of its sedimentation.

KEY QUATERNARY GEOLOGICAL EVENTS OF THE UKRAINIAN HIGHLANDS

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Quaternary deposits of the Crimean and Carpathian Mts lie on the eroded surface of sedimentary and effusive rock of Neogene age (post-Kuyalnikian time) that is appear to be a natural boundary for the Quaternary system. Intramontane depressions of various origins contain heterogeneous sequences representing different stages of the mountainous relief and correlative stratigraphic units of the Eo-Pleistocene, Neo-Pleistocene and Holocene as well.

Eeo-pleistocene is characterized by drastic re-activity of very differentiated vertical tectonic movements, increasing of its pace from the end of Pliocene, reviving of erosion and formation of incised river valleys and steep cliffs and narrow gorges at headstreams. It was an epoch of a final regression of the Neogene marine basins and setup of a continental environment characterized by lacustrine-alluvial, swampy floodplains and coalesced piedmont fan lobes (the Tchopian suite, deposits of the Nikolayevkian series). Simultaneously it was formed a terraced relief and uppermost levels of the Dniester, Prut, Tissa, Dnieper and other river valleys coming to the Black Sea. Common features of those valleys are stipulated by oscillations of the sea level. In this context it should be mentioned alluvial pebblestones and sandy loams of the upper terraces, high (IX–VII) terraces of Dniester and Prut, and the Kyzyldharian pebble series composing the uppermost terraces in Crimea.

Neo-pleistocene is characterized by significant climatic changes from semi-arid through moderate-humid to frigid (glacial) climate with periodic thaws, development of cover and mountain glaciers, formation of glacial, fluvio-glacial, aeolian, and aeolian-deluvial loess rocks. In early Neo-Pleistocene short-term but intensive impulses of tectonic activity took place (especially at its beginning and end) accompanied by deep erosion scours. It was formed VI and V terrace of Prut's and Dniester and their tributaries. In Crimea it corresponds to V (Bulganakian) terrace. In second half of early Neo-Pleistocene in the northwestern part of Cis-Carpathians it was recorded two phases of glacier propagation (Krukenichinian and Samborian) marked by two stages of bottom-moraine rocks. In the Carpathians and Crimea the beginning of Mid-Pleistocene time was accompanied by deep incision of river valleys and accumulation of thick cobble-pebblous rocks in depressions. The cold periglacial conditions govern threre during the Dnieper times with formation of eolian-deluvial deposits on gentle slopes and glacial and glacio-fluvial sediments in the highlands. An outlet of Vistula and San rivers was ponded by a glacier within the Carpathian piedmont. It was formed alluvium of IV terrace of Tissa, Dniester and their tributaries and alluvium of IV (Mandzhilian) terrace in Crimea. Late Neo-Pleistocene was characterized by short-term sharp and non-uniform epeirogenic episodes of an uplift accompanied by incision of rivers and formation of alluvial complexes of the lower terrace level (III–I), and accumulation of eolian-deluvial and loess rock in watershed and slope settings. In Crimea the cover sandy loams of the III Sudakian terrace overlie directly marine Karangatian sediments, and the lower terrace complex is corresponded with moraines of late Pleistocene mountainous glaciation in the Carpathians, respectively. In the headwaters of Tissa and Prut the tracks of local glaciation are marked at the bottom of corries. Loess rocks of the Bugian horizon have distinct permafrost features that are in good coincidence with the Bugian cold epoch characterized by the most severe climate conditions during all Quaternary.

Holocene was characterized by continuous erosion of the Carpathian and Crimean Mts and an accumulation in the piedmont that testify about inherited vertical tectonic movements. The levels of the meadow terraces and scree-clayey sediments on slopes and watersheds had been formed An intensive incision of rivers and ravines, catastrophic activation of slope (landslides) processes and flash floods are often linked to human activity.

AMINOSTRATIGRAPHIC CORRELATION OF LOESS CYCLES ACROSS CENTRAL AND EASTERN EUROPE: PROGRESS AND PROSPECTS

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Since 1987, we have been using the extent of racemization of amino acids in fossil mollusc shells recovered from loess as a means of stratigraphic correlation of loesses and intercalated paleosols in several regions of the Northern Hemisphere. In Europe, we have collected samples from dozens of loess exposures from the Rhine to the Dniepr including sites in Germany, Czech Republic, Slovakia, Austria, Hungary, and Ukraine. Until recently we have used the epimerization of the amino acid isoleucine to characterize and differentiate between loess deposits on the time scale of major glacial cycles (in the sense long used by Czech workers, *e.g.* Kukla, 1975). Thus, we have been able to recognize and differentiate loess of Cycles B, C, D, and E in many parts of this region (Oches, McCoy, and Gnieser, 2000). Because of the high sensitivity of epimerization to temperature and because of large temperature differences between glacial and interglacial intervals, most of the epimerization in fossil mollusc shells occurs during the interglacials. Therefore, we are able to correlate the major interglacial paleosols found between loess units. Our results suggest the following correlations across central and eastern Europe. PKIII of the Czech and Slovak Republics is correlative with the Stillfried A of Austria, the MF 2 of Hungary and the Kaydak soil of Ukraine. PKIV correlates with the two soils of the Basaharc Double of Hungary and the Zavadovka soil in Ukraine. With somewhat less certainty, we correlate PKV with the Gottweig soil in Austria , the BA soil in Hungary, and the Lubny soil in Ukraine. We also hypothesize that the PKVI soil is correlative with the MB soil in Hungary.

We are now beginning a project to study the stratigraphy, chronology, and paleotemperatures of loess of the last glacial cycle (Cycle B) in more detail. We are measuring the extent of racemization of the amino acid aspartic acid in fossil mollusc shells. Aspartic acid racemizes much faster than isoleucine and therefore it provides a means to obtain greater resolution within the last one or two glacial cycles than does isoleucine epimerization. Part of the present research involves using the observed rate of aspartic acid racemization in independently dated (TL, OSL, ^{14}C) shells to calculate paleotemperatures over intervals of time within the periods of loess accumulation. Using this approach we expect to be able to calculate paleotemperature gradients across Europe and to calculate paleotemperature differences between successive intervals of time within the last glacial cycle. In conjunction with this project, we are collecting data relating current loess temperature regimes with present climate in many loess areas of Europe.

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ON THE LOWER BOUNDARY OF THE MIDDLE PLEISTOCENE OF THE LOESSIC FORMATION OF THE DNIEPER BASIN

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The problem of the lower boundary of the Middle Pleistocene of the loess formation of Ukraine is still open to discussion. It is drawn at the foot of the Dnieper, Zavadivka or Orel horizons. The scheme of 1968 (M. F. Veklych *et al.*) was the most grounded stratigraphical scheme of the Quaternary deposits. In each of the Lower, Middle and Upper Anthropogene there were defined 6 horizons, three of them were loess and three soil horizons. Later, as a result of interregional correlation of the Quaternary deposits, the rare Orel and Potyagaylivka horizons dropped out or at the best were attached to the Zavadivka horizon.

The Orel horizon was firstly described by L. Lungerskgauzen (1933, 1934, 1935) in the river Orel basin and in the Moldova area. Its thickness ranges 0.4–1.5 m, sometimes up to 4m. It is composed of brownish-pale-yellow, light brown, in places clayer loess. In the loess there was found the mollus fauna of the following species: *Succinea oblonga Drap., Pupilla muscorum (L.), Vallonia tenuilabris (Al. Br.).*

In the stratigraphical scheme proposed by V. I. Krokos (1927, 1934, 1935), the Orel loessic level is separated from the Dnieper level by the buried soil of the steppe type (Potyagaylivka, as to M. F. Veklych, 1968) that was formed under the warm climate. V. I. Krokos correlated the Orel loess unit with the lower moraine (pre-Rissian) of Stockhorn in Switzerland.

By the way, the Orel loess horizon and the Potyahailiv palaeosol are well exposed in the key site of the Vyazovok village that is planned to be shown to the participants of the Conference. Here, the slope of the r.Sula valley is cut by the deep riverside ravines. In the exposure made in the Voronov ravine , the reddish-brown carbonate soil (1.2 m) and yellowish-pale-yellow loess (0.5 m) underlie the Dnieper horizon. The detailed morphological description and the data of the physical-chemical analysis of these soil and loess are given in our teamwork (M. F. Veklich et al., 1967).

Correlation of the Zavadivka horizon with the Likhvin horizon is also to be specified. In the stratotype of the Likhvin section (t.Chekalin, the Oka river left bank) in the riverside ravines and precipices under the thick stratum of the Dnieper moraine (up to 6m) and glaciao-fluvial deposits (up to 4 m), there is exposed the dark grey soil (1.2 m) overlying the yellowish – pale-yellow loam (0.5 m). Lower lies the Likhvin brown forest soil (1.3 m). Apparently, the upper soil (Ivaniv, as to O. I. Moskvitin, 1967, p. 23) that lies directly under the Dnieper horizon. It may be correlated with the Potyahajliv soil of the Middle Dnieper area, while the loess loam – with the Orel loess. In this very case, the Likhvin horizon is well correlated with the Zavadivka horizon. In the other case it is necessary to lower the Likhvin horizon on 1 or 2 stratigraphical intervals as it is done by O. I. Moskvitin (1976, p. 55), one of the authors of the unified stratigraphical scheme of the Quaternary deposits of the East-European plain.

Thus, the Potyagaylivka and Orel horizons should again take a proper place in the stratigraphical scheme of the Quaternary deposits of Ukraine, while the lower boundary of the Pleistocene of the loessic formation of the Dnieper basin may be made at the bottom of the Orel horizon.

CORRELATION OF THE QUATERNARY TERRACES OF THE PRUTH, THE DNIESTER AND THE LOWER DANUBE

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The hinterland of the Northwest coast of the Black has important advantages for correlation of marine, fluvial and subaerial sequences, because both absolute data and paleontological remnants, and hypsometric levels of sediment bedding may be used. The principal task of my investigations consisted in biostratigraphical study of the alluvial and limane-marine deposits from the lower part of the mentioned river's valleys. The alluvial-deltaic and liman-marine deposits represent the connecting link between marine and fluvial formations, that is why their investigation may significantly facilitate the continental and sea events correlation. They contain numerous remnants, both subaerial organisms and marine ones: macro- and micromammalia, continental and fresh-brackish-marine water Mollusks, Ostracoda, Foraminifers, Diatom, spores and pollen of plants, etc.

For the mentioned valleys there were described and paleontologicaly argumented 12 terraces. For each of them there are both a stratotypical site and the ordinary number, which indicate the place of terrace in their system. The numbers of terrace increase parallel with their age. The 3 oldest terraces (XII-th, XI-th and X-th) have Pliocene age and are characterized by Moldavian and Haprovian mammalian complexes. The alluvial deposits of the IX-th and VIII-th terraces were accumulated during the Early Pleistocene and contain the remnants of Odessan and Tamanian mammalian fauna and Gurian (Apsheronian) fauna of brackish-water mollusks.

The alluvial sediments of the next three terraces (VII-th, VI-th and V-th) were accumulated during the Lower-Middle Pleistocene. In the lower Prut and Danube valleys the height of the above mentioned terraces'socle reaches 25–28, 20–23 and 15–18 m respectively. Their surface levels reach 65–70 m, 55–60 m and 45–50 m respectively. The Nogaisk small mammals complex and Early Chaudian fauna of brackish-water mollusks characterize the VII-th terrace. Subaqueous deposits of VI-th terrace contain the remains of Tiraspolian small mammals complex and Late Chaudian fauna of brackish-water mollusks. The V-th terrace is characterized by Singilian microteriofauna and Uzmarinian complex of brackish-water mollusks. The Upper-Middle Pleistocene in our region includes the subaqueous deposits of the IV-th and III-rd terraces and their surfaces are traced for 35–40 m and 25–30 m respectively. The level of the socle is gradually lowered from 10–12 m near the Prut mouth down to 1–2 m near the town of Izmail in the lower Danube. The terrace IV deposits contain the remains of Singil (Gunki) fauna of small mammals and Paleoeuxinian complex of brackish-water mollusks. That makes it possible to correlate them with the Black sea paleoeuxiniane deposits and with the Kamensk fossil soil of the Russian plain. The III-rd terrace thickness is dated by Khazar complex of small mammals and Uzunlar lagoon mollusks complex, which allow to correlate these deposits with the Uzunlar horizon of the Black Sea. The II-nd and I-st terraces deposits are attributed to Upper Pleistocene. Their surfaces reach 15–20 m and 8–10 m; the socle level reaches +1+2 and -13–17 m respectively. Shkurlat complex of small mammals and karangatian lagoon fauna of brackish-water mollusks characterize the II-nd terrace. The I-st terrace contains rarely remnants of the Upper Palaeolithic mammals and Neweuxinian fauna of brackish-water mollusks.

HUMAN AND LARGE MAMMAL GUILDS IN THE MIDDLE AND LATE PLEISTOCENE OF ITALY

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A successful colonisation of the middle latitudes of Eurasia by human groups only happened, in our opinion, if this gregarious species was able to integrate a vegetal food intake with a substantial amount of meat. Accordingly, human behaviour and adaptation is better understood if comparisons are made with gregarious hunters, such as hyenas and canids. Being omnivorous, however, Middle Pleistocene hominid species can also be compared to bears, which are solitary hunters. Humans also differ from carnivores because their activity is strictly diurnal. Overall, there is ground to believe that this ecologically flexible and adaptable species took advantage of a niche only partially overlapping with the niche of other carnivores. Aim of our analysis is to characterise the faunal assemblages of Italy in which human presence is documented, giving a special emphasis to carnivores, and to define the main characteristics of the environment.

The climatic events of the Pleistocene affected the physical and/or biotic environment and are possibly reflected in concurrent bioevents in multiple lineages. Consequently, there are changes in the fauna and flora richness and diversity. The structure of mammal communities is sometimes affected. In the Italian peninsula, the early Middle Pleistocene is characterised both by firm evidence of a stable human peopling, and by a marked large mammal renewal, which happens progressively in successive phases, with new occurrences prevailing over extinctions. The middle and late Galerian large mammal assemblages are generally dominated by medium/large sized taxa, mainly herbivores, but the percentage of pachyderms become markedly higher. Accordingly, the biomass was possibly steadily increasing, especially at the time of the Isernia FU assemblages. Standing richness progressively increases throughout the Middle Pleistocene, Isernia and Vitinia FUs display a maximum number of species, and the latter FU is also characterized by the highest diversity. As far as carnivores are concerned, however, there is a lower number of species in middle Galerian assemblages, while the occurrence of brown bear and wolf is first documented respectively in late Galerian and early Aurelian faunas.

A moderate community reconstruction characterizes the Galerian/Aurelian transition (early Middle Pleistocene/ late Middle Pleistocene). The faunal complexes of the last interglacial/glacial cycle, which correspond to a rather fragmented environment, are characterised by a limited rate of renewal. After a peak of standing richness during OIS 5 and 4-mostly because of the many small carnivores – there is a steady decrease during OIS 3 and 2, even if this happens in the perspective of the high diversity which characterises Italy all over the Middle and Upper Pleistocene. The decline of the Neandertals, and the colonisation of Italy by anatomically modern humans, are part of this final scenario.

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THE PALEO- AND PETROMAGNETIC RECORD IN THE POLISH AND UKRAINIAN LOESS-PALEOSOL SEQUENCES

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About 700 oriented samples from five loess-paleosol sections located in the Black Sea region, the western Ukraine and Poland (Lublin Upland) were the subject of a paleomagnetic and petromagnetic study. Strong magnetic enhancement is observed in the cambisols, chernozems and iluvial horizons of the forest (podzolic) and leached brown type (brown-erde) soils. Distinct magnetic depletion or dilution occurs in the gley soils and the leached horizons of podsols and brown type soils. Magnetic enhancement in the section from Black Sea region was not simply dependent on paleotemperature. Soils from the interstadial periods could be magnetically enhanced to the same degree as soils which were formed during interglacials. In the Polish and Ukrainian loess-palesol sequences, paleorainfall could be a significant factor controlling the susceptibility signal in addition to paleotemperature. The degree of warming of paleoclimate can be expressed by the amount of secondary maghemite that was formed in the studied paleosols.

All sections were deposited after the Brunhes/Matuyama paleomagnetic reversal. No remarkable paleomagnetic event was encountered. However, very distinct directional changes associated most probably with the secular variations were observed in the Polish and western Ukrainian sections. These changes can serve as a stratigraphic correlation tool for comparison with petromagnetic data.

POLLEN DATA OF UPPER PALEOLITHIC SITE DOBRANICHIVKA

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The cultural layer of Dobranichivka site was formed at the final stage of Upper Paleolithic, around 14–12 000 years ago. At present, the site is located in the forest-steppe area with prevalence of chernozem soils. All sections of Upper Pleistocene sediments around the site have been investigated. The cultural layer is a thin (0.2–0.5 m) brown embryonic soil of cold climate. Its pollen spectra are dominated by pollen of herbs (95 %). There are few pollen of tree: pine, alder, willow, birch, including Betula humilis. The vegetation was of a periglacial forest-steppe type, with small areas of pine and birch forests, in which the herb cover has a significant portion of heliophytes (*Helianthemum, Scabiosa, Cichorium, Euphorbia*). Embryonic soil was formed under conditions of slight improvement of climate. The number of tree pollen increased, and among them, pollen of oak and lime appeared. Herbetum mixtum prevails in NAP. The herbs were very diverse in ecological and phytocenotic meaning. There were a lot of representatives of disturbed substrata – *Bothrichium lunaria, Chenopodium album*. There were also a lot of pollen of xerophytes and halophytes from *Chenopodiaceae* family, characteristic for steppe vegetation. Pollen of Betula humilis and spores of microtherms *Bothrichium boreale* and *Selaginella selaginoides* are also present. Presence of pollen *Eurotia ceratoides* evidences wide development of periglacial coenoses. The vegetatational cover was characterized by complexity and diversity connected with heterogeneity of the relief and a variety of soil conditions. In the embryonic soil, many plant remnant have been also revealed, such as bark and wood of alder and birch, bark pine, rests of *Cyperaceae*, *Phragmites* and water plants.

PALYNOLOGICAL STUDY OF THE MIDDLE DNIESTER PALEOLITHIC

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The area of the Middle Dniester is well known in Europe due to unique multi-layer Paleolithic sites. By I. K. Ivanova, who has devoted many years to geological and geomorphological study of this area, the Dniester group of the Paleolithic sites is one of the largest centers of the developed Paleolithic in Europe.

The study of these sites was carried out since the 50-ies, with use of a complex of methods – paleogeographical, geomorphological, paleontological, lithological, paleopedological and palynological. These stidues enabled the reconstruction of the evolution of the Paleolithic culture, the environmental conditions (including vegetation) of the ancient man. Unfortunately, most sites are now flooded by the Dniester reservoir. However, this area still attracts the attention of the researchers from different countries.

The area of Middle Dniester is presently in the forest – steppe zone, according to physical-geographical zonatuion. However, in opinion of geobotanists, this area belongs to the European province of deciduous forests. In 17th century, oak and oak-hornbeam forests occupied 70 % of the area, due the significant erosional dissection of the territory and its elevated position.

The vegetatitional cover of the Late Pleistocene was considerably different from the modern one and indicted the conditions of a cool and wet climate, as the palynological study of the sites Molodova 1, Molodova 5 and Korman 4 has shown. In the certain periods, there were the conditions for the development of such cold-resistant plants as *Bothrichium boreale, Selaginella selaginoides, Betula humilis, Betula nana*, and in the most severe times – for *Alnaster fruticosus*. Birch and pine sparse growth of trees, as well as srubs from *Betula humilis, Betula nana* and *Alnaster fruticosus*, participate in the periglacial forest-steppe vegetation. It was alternating with cold steppes and tundra-steppes with Herbetum mixtum-Gramineae associations. On rocks and eroded slopes, xerophytes and representatives of the arctic-alpine flora grew. Deciduous flora was absent at all, or occurred in small quantities in the short-term periods of interstadials. The interstadial Brörup is most completely characterized by the palynological data from the Kishlyanky ravine (data by N. Bolikhovskaya). In the profile of the site Korman 4, the warming in the interstadials Brörup and Odderade were also revealed. The formation of the cultural layer of the Molodova 1 site (with the Mousterian settlement) and of the overlying deposits occurred in a cold and continental conditions of periglacial forest-steppe of the Mid Pleniglacial. The cultural layers of the Upper Paleolithic site Molodova 5 and Korman 4 were dated to the age of the Bryansk fossil soil. In pollen spectra, an increase of arboral pollen is observed, and coniferous taxa are predominant, whilst broad-leaved taxa occurred in a small quantity. The Upper Paleolithic cultural layers formed during the period posterior to the Bryansk interstadial, were connected with the most cold period. Pollen *of Betula humilis, Betula nana* and *Alnaster fruticosus* and spores of microtherms species, together with pollen of *Eurotia ceratoides, Kochia prostrata, Ephedra distachya* characterize a periglacial forest-steppe. The warmings of the Lasko and Alleröd inrestadials are traced by the occurrence of broad-leaved pollen. The Upper Paleolithic layers are traced in the upper part of the section. The Mesolithic layers, according to the detailed palynological characteristics, are related to the bottom of the Holocene soil of the Korman 4 and Molodova 1 sites.

CHANGES OF MINERAL COMPOSITION OF THE MIDDLE AND UPPER PLEISTOCENE DEPOSITS OF THE TERRITORY OF UKRAINE

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A characteristic feature of the Pleistocene cover of the area of Ukraine consists in a clear alternation of deposits of warm stages (palaeosols of various types) and cold stages (loesses, loessic loams, clays, moraines, lacustrine

glacial, fluvioglacial deposits) that is a result of sharp changes of palaeogeographical conditions (bioclimatic ones, first of all). The change of conditions is fixed in the mineral material of deposits, especially of its clay component.

The complex investigation of the clay material (Perederij, 1970–2001) of the Upper and Middle Pleistocene deposits of different regions of Ukraine (key sites, boreholes) allowed to get a rather complete characteristic of the mineral composition of the stratigraphical units, to define their peculiarities and to recognizing the trends of changes.

Composition of the thin dispersed fraction (<0.001 mm) of the loess-soil deposits is polymineral. The clay material is represented by minerals of the smectite group (montmorillonite, beidellite, nontronite), mixed layer hydromica-montmorillonite formations, hydromicas, kaolinite, halloysite in various proportions. Chlorite, vermiculite, goethite, calcite, gypsum, quartz are present. Quantitative and qualitative differences are recognized. The loess horizons are notable for the low contents of the clay material (10–20% of silt), for hydromica and hydromica-montmorillonite composition of the mineral mass and for its weak weathering. The quantitative differences of the minerals distribution in the thick same-aged loessic (the Bug, Tyasmyn, Dnieper, Tyligul) horizons are observed – contents of hydromicas (an indicator of cold periglacial conditions) decrease towards the south at the expense of the increase of the smectites quantity. Hydromicas dominate the deposits of the Dnieper stage of the glacial zone that is characteristic for the glacial conditions. The loess horizons of a small thickness (Prychernomorsk, Yday) are notable for the more weathered mineral mass; the content of the hydromica component decreases in it.

Warming and increase of humidity in soil formation stages led to changes in mineral composition of the clay material. Soil horizons depending on palaeogeographical conditions of the time of their formation and types of soils are characterized by more weathered mineral mass, high degree of dispersity (28–45% of silt). The main component of the clay material of the palaeosols are minerals of the smectite group (an indicator of moderate climatic conditions), as well as the mixed layer formations of the hydromica-montmorillonite type (indication of intensity of soil forming processes and transformation of mineral mass). Hydromicas in soils are present in small amounts.

The increased content of kaolinite (an indicator of hot, humid conditions) is characteristic for the brown forest, cinnamonish soils of the Zavadivka and Martonosha stages in the middle and southern parts of Ukraine. This peculiarity is observed in the Vytachiv soils of the Middle Pridnieprovje as well.

Differences in the mineral composition of the clay material within the soil suites and stadials are recognized that is connected with changes of conditions of their formation.

There are observed the differences in distribution of calcite, gypsum (indicators of aridity of conditions, seasonal distribution of precipitations) – they are present in a considerable quantity in the Dofinivka, Vytachiv, Zavadivka soils as well as in the Bug and Prychernomorsk loesses of Donbass, Lower Pridniestrovje, Prychernomorsk.

The presence of a considerable content of the iron and manganese sesquioxides (indicators of humidity and conditions of hydromorphism) is characteristic for the brown forest and burozem-like soils of the Vytachiv, Pryluky, Zavadivka stages of the Middle and Porozhistoye Pridnieprovje, Donbass.

The results of investigation of the mineral material of the loess-soil deposits show temporal (rhythmical, directed) and spatial (regional, zonal) changes of its composition that is connected with the repeated changes of palaeogeographical conditions in the Middle and Late Pleistocene in the territory of Ukraine.

FORMATION OF MINERALS IN LOESS AND SOILS

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Confirmation of the concept on loess as a product of steppe soil formation by Hunjgarian loess experts and soil researchers.

For his working hypothesis Berg (1916) involved several data from microbiology, soil genesis and climatic zones. In the Carpathian Basin plain loesses and of them the so called infusion loesses are the most frequently encountered loess-like deposits. Their grain size distribution and texture was attributed by M. Pecsi (1982) to steppe soil formation and not to the way of the accumulation of its material.

Recently E. Nemecz and Zs. Hartyáni (1995) carried out detailed granulometric and mineralogical investigations into Hungarian soils formed on loess and paleosols interbedded in loess sequences studied in sections. Both in the recent loess soils and in paleosols buried in loess series a typical double particle size maxima occur (<5 mm and 20–45 mm). Quartz as a main mineral component of loess falls into the 25–40 mm fraction similar to felspars, muscovite and dolomite. Detailed investigations indicate main mineral components of loess, oxides and rare minerals to have formed and arranged basically during soil formation and led to a specific loess structure (Fig.1, 2. and 3.).

The new method of granulometric and mineralogical analyses of soils, loesses and loess series seems to prove a concept claiming that particle size distribution in loess and intercalated paleosols is mainly related to processes of loessification and soil formation. Recognition and confirmation of this will affect dating methods of loess and paleosols in the future.

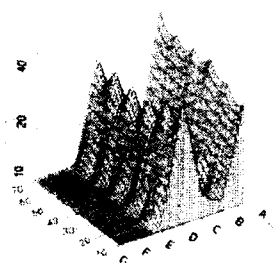


Fig.1. Particle-size distribution of a paleosol at Paks (PMB)

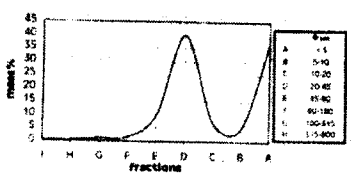


Fig.2. Particle-size distribution of 16 recent soils collectedin Hungary

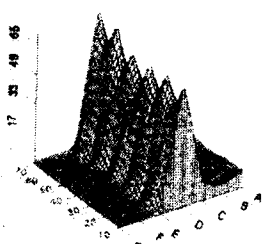
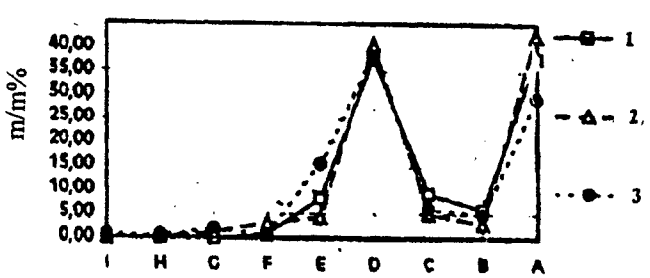


Fig.3. Particle-size distribution of quartz of a paleosol at Paks(PMB)



Loesses

Paleosols

Recent steppe soils

Average grainsize distirbution

WAS EAST-EUROPEAN LATE CENOZOIC HERPETOFAUNA STABLE?

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The traditional idea that has already been accepted in Western Europe is that all Pleistocene herpetological material can be related to modern species. Holman, in his summerizing work, identifies only 4 unquestionably extinct species in Pleistocene deposits of Britain and Europe. All others species originally described as extinct ones, are considered to be either their synonyms or problematic ones. All findings in Upper Cenozoic sediments are considered to be variants of modern species variability. It follows that nearly all amphibian and reptile fossil forms had extincted long before the start of glaciations, and the modern species that survived glaciations, existed for 1.8 million years within the present habitats in conditions of climatic changes. This occurred along with a great amount of extinct species in other animal groups.

I think that the range of amphibians and reptiles variability are greatly overstated. When making the decision to attribute a fossil form to the modern or extinct species, one should take into account the taphonomy rules. The short duration of Quateranry can not be the basis for denying of the evolution at this time. For instance, the time of deposition of one ammonite apt zone is about 750 000 years, and is comparable with the duration of the Pleistocene. On the other hand, the change of faunistic communities should possibly take a shorter time than that of the zone formation. As a rule, this time period is not reflected in geological history that can be connected with hiatuses during sedimentation. Rather thick and various sediments were accumulated during the Pleistocene. It proves that the Earth's history at the Pleistocene, is recorded much more completely and in more details, and we can discover much more extinct or rare forms than for the previous stages.

I would like to mention the known fact of uncompleteness of geological records and the lost of transitional forms in buried conditions. Numerous advanced species (i.e. those typical for certain time and place) are buried, whereas rare forms are buried quite seldom. Such statistical correlations should be observed in many cases. For instance, a species demonstrates a typical bone morphology, peculiar to majority of individuals, as well as non-typical variants of variability including anomalies of development and pathology. It is natural that the bones with a typical morphology have a greater chance to be buried, whereas there is little or no probability of burial of non-typical variants. That is why if we find in a locality rare examples with a slightly different morphology among a great amount of typical modern bones, we can speak about variability variant. But if the bones, different from typical modern ones, are still found in a certain number, we may confirm that they show a typical species morphology for certain time and place and can be described as a new taxa. It is not possible to deny the existence of forms described on the basis of singular findings. I think the criteria for describing of new herpetologcial forms should be the same as for all fossils. The problemn of herpetofauna stability basically means whether herpetofauna has/or has not a stratigraphical significance. I think it has.

The work is done under financial support of Russian Foundation for Basic Research (grant 01–04–48161).

THE TAPHONOMICAL CONDITIONS OF THE FAUNA AND MATERIAL CULTURE AT THE MEDZHIBOZH SITE

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The Medzhibozh fauna site is connected with the multilayered Paleolithic site and related to the Likhvin interglacial (phase Mauer). It is located on the left bank of the Pivdenny Buh River near the town of Medzhibozh (the Khmelnitsky region of Ukraine). The information about the site was published in the papers of Laskarev (1914), Gozhik (1961) and Rekovets (1994). Artifacts were also found by the expedition of the Nizhin University in 2000. The sequence, about 8 m thick, rests on gray granites of the Ukrainian crystalline shield. It consists of different facies of ancient alluvium about 3 m thick (the IIIrd terrace of the Pivdenny Buh), and the series of loams/loesses with embedded fossil soils. In the excavation, V. K. Pyasetsky identified 15 levels. 6 of them contain mollusks, sub-vertebrate and mammal remains. Remains of material culture have been found at the base of alluvium (Acheulian), as well as at the lower part of subaerial deposits (Upper Paleolithic). The alluvium (levels 9–14) contains the remains of various species of mammals. Actually, at all levels, *Arvicola mosbachensis* and *Microtus* sp. (arvalis groups), as well as numerous shells of terrestrial and freshwater mollusks have been found. The largest number of species of small mammals (up to 10) has been found in the upper levels of alluvium (layers 9 and 10). In the lower levels, the remains of *Cervus* sp., *Trogontherium* sp., *Marmota* cf. bobac, *Microtus* cf. agrestis have been found. Two last species have been found in such old deposits of Ukraine for the first time.

The remains of species *Insectivora, Muridae, Spermophilus, Spalax* are very rare. No remains of Ochotonidae, Dipodidae, Cricetidae have been found. On the whole, the theriofauna includes 6 species of big mammals and 17 species of small ones: *Mammuthus trogontherii, Dicerorhinus* sp., *Cervus* sp., *Capreolus* sp., *Ursus* cf. deningeri, *Sus* sp., *Marmota* cf. bobac, *Spermophilus* sp. *Lepus* sp., *Castor* cf. fiber, *Trogontherium* sp., *Apodemus* sp., *Micromys* sp., *Clethrionomys* sp., *Mimomys milleri, Arvicola mosbachensis, Microtus gregalis, M. oeconomus, M. nivaloides, M. arvalidens, M. cf. agrestis, Talpa* sp., *Sorex praearaneus, Sorex* sp. Remains of Aves, Reptilia, (snakes, lizards, tortoises), Pisces also have been found in the alluvium. The remains of the fauna from different levels of alluvium are probably of the same geological age.

On the top of granites, the Acheulian flint chip has been found, and at the base of loess-soil deposits, the Mousterian (?) and Upper Paleolithic chips have been found (in opinion of V. Usik). It is quite possible that in Medzhibozh, artifacts of the Heidelberg man, the Neandertal man, and the early *Homo sapiens* are represented. The theriofauna of Medzhibozh site belongs to the early phase of the Singil' complex and reflects the existence of mesophytic landscapes of the Likhvin interglacial. Besides, the site provides a link between the mesophytic faunas of Western Europe and xerophytic faunas of South-Eastern Europe.

LATE PLEISTOCENE ENVIRONMENTS OF THE CENTRAL UKRAINE

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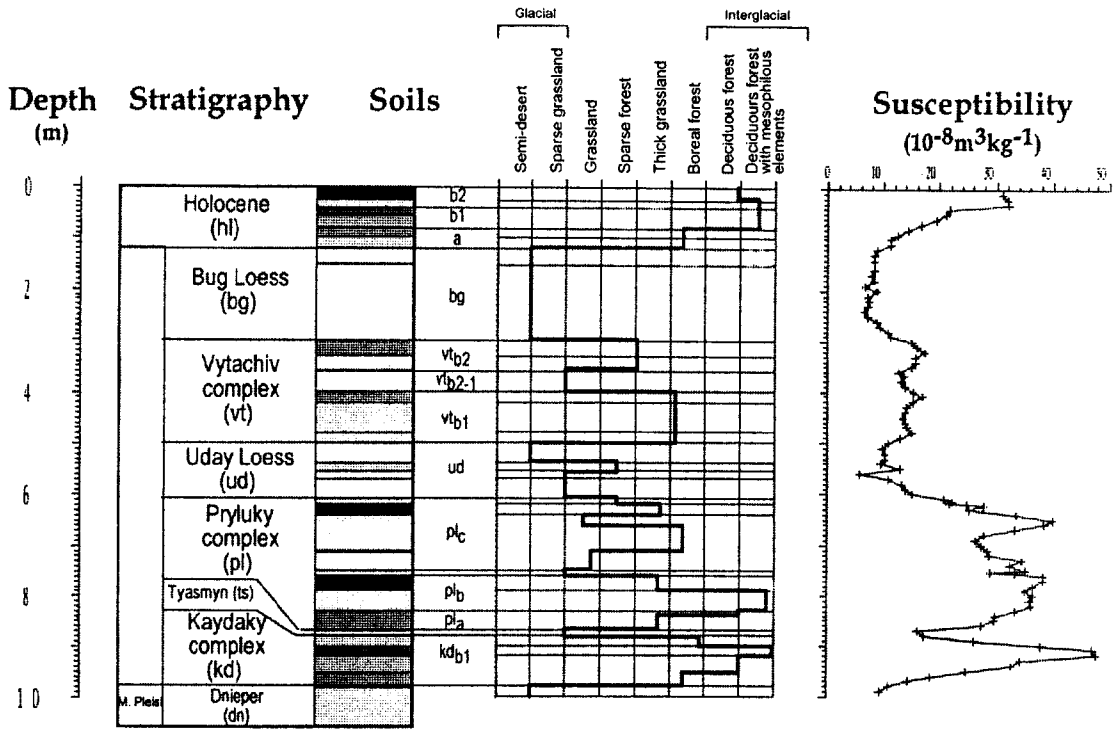
The Vyazivok loess sequence from the Dnieper Plain, Ukraine, documents regional environmental changes during the late Pleistocene and Holocene. Pedological and palynological analyses and low-field magnetic susceptibility document changes from dense temperate forest during the last interglacial maximum to open, harsh, loess steppe during the latest Pleistocene. The Vyazivok section overlies hillwash derived from a lower Pleistocene terrace and consists of two stratified soil complexes (Kaydaky and Pryluky; marine isotope stage (MIS) 5 equivalent) separated a layer of eolian dust (Tyasmun silt). The lower soils in both complexes formed within forest. These soils are overlain by the Uday (MIS4) and Bug (MIS2) loess units, that are separated by boreal soils of the Vytachiv (MIS3) complex. The coldest conditions within the record occurred in the youngest loess. Holocene soils cap Bug loess. The Vyazivok section shows remarkable similarities with other classical loess sequences in western Europe, the Czech Republic, and Austria. The Kaydaky, Pryluky and Vytachiv deposits, correlated with the PKIII, PKII and PKI soil complexes, respectively of the Czech Republic. The Tyasmyn and Prylyky silt layers correspond to marker horizons from central Europe.



Stratigraphy of the Late Pleistocene at Vyazivok. Low-field magnetic susceptibility and reconstruction of the environments. (after eau et al, Quat. Res. in press)

THE SIGNIFICANCE OF UNIONIDAE FOR DIVISION OF ALLUVIAL DEPOSITS

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The fluvial valleys of Dniester and Dnieper and their tributaries form well-distinguished terraces which are built with alluvial deposits and overlaid by subaeral loess rocks. There are fresh water mollusc fossils in the geological sections but only Unionidae are of a great interest for a stratigraphy. Due to works of A. G. Ebersin, I. Ya. Yatsko, A. L. Tshepalyga, P. Ph. Gozhik and other the majority of finds of Unionidae were published. These materials and data on review of collecting the shells from the numerous localities allow exactly to outline different levels in the development of Unionidae that caused by both evolutional and migration processes.

The upper layer of the Pliocene alluvium is characterize by the Rashkiv complex with Unionidae of the group *Bogatschevia tamanensis* E b e r s. The beginning of the Eopleistocene is marked by a Boshernitsky complex (A. L. Tschepalyga) where Unionidae ex. gr. *sturi* has a great importance together with mollusc fossilis of above-mentioned complex. Their further development in the way of weaking their lock and shellelongation took place in a Velykokosnitsky complex and finished in a Mykhalovsky complex. There were widely Unionidae (s. str.) present in the Mykhalovsky complex. Zonal extinct species in particular subtropical zone have a great significance for the division of the Neopleistocene alluvial deposits.So for the V terraces it is *Potomida litoralis* C u v., *P. kinkelini* H a a s and *Unio tiraspolitanus* T s c h e p. For the III terraces it is *Unio tiberiadensis* L e a. The representatives of genus *Pseudunio* inhabited the water streams of Ukraine during the general fall of temperature and increasing the speed of waterstreams, water transparancy. It was observed during the forming the lower thickness of alluvium of the V and III terraces.

PALYNOSTRATIGRAPHY OF THE ALEXANDRIAN (= HOLSTEINIAN) DEPOSITS OF THE DNIEPER BASIN.

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Detailed analysis of the most representative pollen diagrams of Alexandrian age of the territory of Belarus (Machnach, 1971; Machnach, Yakubovskaya, 1975; Gruzman et al., 1975; Rylova, Khursevich, 1980; Putevoditel ..., 1981; Rylova et al., 1999; Rylova, Khursevich, 1999 and others) allowed to provide a base for development of a biostratrigraphic subdivision of this part of Pleistocene in this country. Five regional pollen assemblage zones (R PAZ alk 1 – R PAZ alk 5) have been distinguished (Rylova, 1998).

In the Dnieper Basin, the best developed Regional Pollen Assemblage Zones have been found in the following profiles: Matveev Rov (stratotype), Dobraya-874 in Mogilev region, and Seilowichi-49 in Minsk region.

The biostratigraphical subdivision presented here covers, besides the Alexandrian interglacial, also the Late Glacial of the preceding glaciation and the Early Glacial of the next glaciation.

NAP-*Hippophae-Selaginella selaginoides*; bz-f-1 (bz – Berezina Glaciation) R PAZ: NAP more than 25%, Hippophae up to 78%, *Selaginella selaginoides* up to 21,8%. In the landscape tundra-steppe type of vegetation dominated. Herb and dwarf shrub communities with heliphilous plants developed.

Betula-NAP; bz-f-2 R PAZ: *Betula* (incl. *B. nana* and *B. humilis*) up to 80%, *Picea* – 7%, *Larix* – 2%, NAP up to 22%. Phase of the development of loose birch forests and tundra-steppe with single stands of tree-birches.

Betula-Pinus; alk 1 R PAZ: *Betula* up to 67%, *Pinus* – 51%, *Picea* – 17%, *Alnus* – 30%, *Larix* – 4,5%, *Juniperus* up to 2%. Phase of the development of birch and birch-pine forest with spruce, larch, alder and juniper. Retreat of herb communites.

Picea-Pinus-Alnus; alk 2 R PAZ. (There are two subzones have been distinguished: *Betula-Alnus* and *Picea-Alnus*): *Picea* up to 58%, *Pinus* – 89%, *Betula* – 25%, *Alnus* – 50%, *Abies* – 5%, *Quercus* – 4%, *Tilia* – 8%, *Ulmus* – 4%, *Carpinus* – 7% and *Corylus* up to 4%. Phase of the development of spruce-pine forests with tree-birches and a small admixture of broadleaved trees.

Abies-Carpinus-Quercus; alk 3 R PAZ: *Abies* up to 45%, *Picea* – 40%, *Pinus* – 80%, *Betula* – 36%, *Alnus* – 70%, *Quercus* – 18%, *Tilia* – 4%, *Ulmus* – 3%, *Carpinus* – 40% and *Corylus* up to 10%. Phase of fair-spruce-pine forests and deciduous mixed forests with fair, hornbeam ,oak, elm and small admixture of lime. Also alder forest communities were developed.

Abies-Picea-Pinus; alk 4 R PAZ: *Abies* up to 46%, *Picea* – 41%, *Pinus* – 98%, *Betula* – 25%, *Alnus* – 35%, *Quercus* – 5%, *Tilia* – 1%, *Ulmus* – 2%, *Carpinus* – 10% and *Corylus* up to 2%. *Phase* of fir-spruce forests with an admixture of *Betula, Alnus, Carpinus* and others thermophilous trees

Pinus-Betula-Larix; alk 5 R PAZ: *Pinus* up to 98%, *Abies* – 11%, *Picea* – 10%, *Larix* – 5%, *Betula* up to 28%. Phase of mixed pine-birch forests with spruce and larch.

Cores Seylowichi-49 and Stary Sverzhen-58 (on Kopyl morainic ridge) are typical Early Dnieper Glaciation profiles. In these profiles, sediments of the Nieswizh and Kopyl stadials and the Seylowichi and Swierzen interstadials have been studied, as well as the beginning of the Middle Dnieper Glaciation.

EVOLUTION OF THE FLORA AND VEGETATION OF BELARUS DURING THE EARLY DNIEPER TIME

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According to palynological and diatom data, the Early Dnieper time interval including two stadials and two interstadials has been most completely studied in two sections in the territory of Belarus: at Seilovichi-49 (76.85 – 71.8 m) and at Stary Sverzhen-58 (33.5–25,6 m) located on the northern slope of the Kopyl morainic ridge (Rylova et al., 1976, Rylova, Khursevich, 1999).

Nesvizh stadial: *Pinus*-NAP (dn-s-1) R PAZ – sparse pine-birch forests with an admixture of *Larix* and *Picea*, an increase of herb associations – forest-tundra. NAP-*Betula-Pinus* (dn-s-2) R PAZ – dwarf shrub open communities with *Betula* nana and herbs; small wood patches – tundra and forest-tundra (cold subarctic climate).

Seilovichi interstadial: *Betula-Pinus-Larix* (dn-s-3) R PAZ – boreal forests with *Betula, Pinus, Larix* and admixture of *Picea.*

Kopyl stadial: *Betula-Pinus-Artemisia* (dn-s-4) R PAZ – dwarf shrubs and herb communities with few stands of tree birch, larch and spruce: forest-tundra associations point to a new cold oscillation.

Sverzhen interstadial: *Pinus-Larix-Betula* (dn-s-5) R PAZ – mixed pine-larch-birch forests with small admixture of spruce.

In the profile Stary Sverzhen – 58, above the sediments of Sverzhen interstadial, there are younger sediments characterized by NAP – *Betula nana* R PAZ. In this zone, steppe-tundra type of landscapes developed. Periglacial type of vegetation undoubtedly points to a strong cooling which occurred most probably at the beginning of the Middle Dnieper Glaciation.

Diatom successions revealed in these sections reflect the sedimentation conditions in paleobasins of the different type.Thus, in the section Seilovichi-49, the successive change of mostly planktonic diatom assemblages with a small participation of epiphytic species has been recorded not only in the Nesvizh and Kopyl stadial deposits, but also in the Seilovichi and Sverzhen interstadial layers, that proves the existence of a relatively deep ancient lake throughout the Early Dnieper time. During the stadials mentioned above, *Aulacoseira granulata* f. *curvata* or A. *ambigua* f. *curvata* and *Cyclotella schumannii* inhabited this paleolake as dominants, and *Fragilaria inflata* as an accompanying species. Diatom assemblages of the interstadial intervals were represented by a high frequency of planktonic taxa *Cyclotella schumannii, Aulacoseira granulata, Stephanodiscus niagarae* var. *insuetus* and by a small number of epiphytic species *Fragilaria (F. brevistriata, F. construens*).

Another type of diatom succession (benthonic-epiphytic or epiphytic-benthonic type) has been found in the section Stary Sverzhen-58. In this section, *Amphora pediculus, Fragilaria pinnata, Gyrosigma attenuatum, Naviculla scutelloides* prevail in the Nesvizh stadial sediments, various *Fragilaria, Navicula, Cymbella ehrenbergii, Amphora libyca* – in the Seilovichi and Sverzhen interstadial deposits, *Fragilaria construens, F. pinnata, F. brevistriata* – in the Kopyl stadial sediments, and again various *Fragilaria, Navicula, Cymbella ehrenbergii* and *Amphora libyca* – in the Sverzhen interstadial unit, and *Fragilaria brevistriata, Martyana martyi, Amphora libyca, Gyrosigma attenuatum* – in the sediments accumulated at the beginning of the Middle Dnieper time. The diatom succession described above corresponds to a shallow paleobasin existed near the village of Stary Sverzhen during the Early Dnieper and at the beginning of the Middle Dnieper time intervals.

ENVIRONMENTAL IMPLICATIONS OF THE HOLOCENE LOESS PALEOSOL SEQUENCE IN THE SUBTROPICAL REGION OF NORTHWEST ARGENTINA

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The Chaco plain is an extensive territory situated between the Parana River and the pre-Andean ridges of worthwest Argentina and represents the subtropical transition between the southern temperate and northward tropical and equatorial suouthamerican regions. The region is covered by relative shallow loess layer, interbeded with paleosols, which depth increase regularly toward the west and Southwest suggesting that the dry Andes piedmont would have been de source of the loess parent material. During the last two decade progress has been made in the knowledge of the Late Pleistocene Argentinean loess covering the Pampa and Chaco plain but few is known about the loess from the Holocene period. Here we present the extrinsic and intrinsic characteristic and spatial distribution of three loess sequences with two well-defined paleosols that cover the western Chaco plain. The sequence cover an interval from lower-middle to late Holocene based in the available dating. In general, the grain size, physic and chemical characteristic and mineral assemblage resemble that of the Late Pleistocene loesic materials present in the Chaco plain and also in the pre-Andean valleys. The morphological character of the paleosols are very similar if compared with that of the present soils, showing a Bt horizons well developed and the A horizon truncated or partly eroded. In general, the spatial distribution and morphology and degree of development of the paleosols follows the present pluvial gradient. Thus, the depth, structure, illuviation, grain size, etc. encrease from the East toward the West (as happen with the present) soils in response to the rainfall encrease. In the other side, is intriguing that the paleosols are clearly related with the volcanic ash layer, at least in respect to the two oldest ones, suggesting contemporarity or causality in relation it's genesis or/and evolution. Although loess-paleosol sequences have not been found in the loess of Lower Holocene or Altithermal age, the more humid and warmer? environmental condition of the Neoholocene gave rise to a well-developed paleosol followed by two palaeoedaphic sequences during the Upper Holocene. The presence of loess accumulation during the Holocene contradicts the classical notion of discrete soil-forming intervals during interglacial phases, but in our region with an increasing dominance of pedogeneis over the period of loess accumulation.

MIDDLE AND UPPER PLEISTOCENE STRATIGRAPHY IN THE ROER VALLEY GRABEN (THE NETHERLANDS): A TERRESTRIAL SEDIMENTOLOGICAL AND PALEO–ECOLOGICAL RECORD OF REPEATED CLIMATIC CHANGE

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On a Quaternary time-scale, the Roer Valley Graben in the southeastern Netherlands is a continuously subsiding tectonic basin, which constantly provided new accommodation space. Until the early Middle Pleistocene, this space was mainly filled by deposits of a mixed Rhine-Meuse river system. After the eastward shift of the rivers Rhine and Meuse in the Middle Pleistocene however, the larger part of the Roer Valley Graben was left without a major depositional system. Since then, sediments of eolian, lacustro-eolian and local fluvial provenance filled the graben, leading to a complex pattern of small-scale depositional environments. Periglacial climatic conditions during this period have been recorded in the sedimentary column by the occurrence of at least three major cryoturbation levels.

The present study aims at unravelling the sedimentary sequence of the Middle and Upper Pleistocene deposits in the Roer Valley Graben and establishing its significance for Late-Quaternary chronostratigraphy and climatic development. The paleogeographical development has been reconstructed using a combination of lithological and sedimentological analyses of 13 undisturbed cores, the geological interpretation of cone penetration tests and the use of a dataset of ~10,000 core descriptions. Palynological and geochemical analyses enabled to reconstruct the paleo-ecological situation in the Roer Valley Graben during subsequent climatic periods. OSL-dating was used to gain absolute time control.

Results show that at least three glacial-interglacial cycles have been recorded in the upper 30 meters of sediment. Glacial periods are characterised by silt and sand with cryoturbation levels. Involutions with an amplitude of 1–2 m occur, as well as levels of frost cracks and wedge cast polygons. In these deposits, pollen is generally scarce, but analysis of the pollen content of humic loam layers and peaty intervals indicates cold and wet conditions in an open landscape with almost no trees. Calcareous loam layers sometimes contain a terrestrial and freshwater mollusc fauna with subarctic elements. The cryoturbated silt-sand levels alternate with at least three large-scale organic levels. These are characterized by a sharp lower boundary and consist mostly of peat and sandy peat. Pollen content of these three organic layers indicates a temperate mixed-forest in the lower part and acid-wet conditions in the upper part of the successions, suggesting that these levels were formed during the second part of a warm climatic interval.

The Late-Quaternary sequence in the Roer Valley Graben indicates that sediments were preferentially preserved during cold (glacial) periods and at the end of warm periods. This seems to be mainly a result of repeated changes in local hydrological regime, leading to temporarily wet conditions in the graben. The establishment of permafrost and changes in effective precipitation may explain these hydrological changes, suggesting that sediment preservation potential is directly related to climatic change.

GEOCHRONOLOGY OF GEOLOGICAL EVENTS IN THE QUATERNARY PERIOD OF UKRAINE

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The Quaternary period covers a chronological interval from 1,650,000 years and is characterized by such geological events as continental glaciations, loess-soil formation; the forming of modern rives valleys and contours of the Black and Asoy Seas. In Ukraine the lower limit of the Quaternary period is drawn at the base of marine Chauda deposits or on the top of Kuyalnik deposits and their alternative continental analogies (red-brown (skifsky) clays), i.e. in paleomagnetic episode Olduvey with dating 1,650,00 years.

The chronological scale of the Quaternary system is following: Eo-Pleistocene has the chronological interval from 1,650,000 years to 700,000 years; Neo-Pleistocene – from 700,000 to 10,000 years; Holocene – from 10,000 years to the present time.

In Ukraine within the limit of Eo-Pleistocene two climatic-stratigraphic horizons have been distinguished: Odessky and Nogaysky. There was enormous the Apsheron transgression of the Black and Asov Seas in Eo-Pleistocene. At that time the climate was warm and humid, close to subtropical one. Terra rossa soil was formed.

There are Early, Middle and Late epochs in Neo-Pleistocene. Early Neo-Pleistocene epoch (700,000–400,000 years) is characterized by very sharp landscape-climatical changed under changing warm and cold epochs. There were at least three warm and three cold epochs. The climate was hardly continental. By the end of Neo-Pleistocene (510,00 years ago) Oka (Mindelian) glaciation took place. In Middle Neo-Pleistocene (400,000–150,000 years ago) the long Zavadovsk (Likhvin-Mindel-Riss) interglaciation time gave place to vast continental (Dnieper) glaciation (280,00–240,00 years ago) covering the most part of Ukraine and changing the landscapes of the previous epochs. Late Neo-Pleistocene began with significant rise in temperature 1500,00–70,000 years ago. This was the Priluki (Riss-Wurm) interglacial time with short-term warm and cold epochs. The climate was humider and warmer than the present one. The late Valdai (Wurm) glaciation (35,000–20,000 years ago) resulted in sharp temperature fall and change of landscape-climatic zones.

ON THE GENERAL STRATIGRAPHIC SCALE OF THE QUATERNARY

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There only exists the subdivision of the Quaternary into two series: Holocene and Pleistocene in the International stratigraphical framework published in 2000 year (as well, as in the earlier International stratigraphicalframeworks). Meanwhile there is a need to unify more detailed subdivision of the Quaternary at the international level. The two frameworks are competing at this point: Westeuropean and Russian (Table).

<table>
<tr><th>System</th><th>Series</th><th>Age Ka</th><th colspan="2">Westeuropean scale</th><th colspan="2">Russian scale</th></tr>
<tr><td rowspan="7">Quaternary</td><td>Holocene</td><td>10</td><td colspan="2">Holocene</td><td colspan="2">Holocene</td></tr>
<tr><td rowspan="6">Pleistocene</td><td>130</td><td rowspan="6">Pleistocene</td><td>Upper</td><td rowspan="3">Neopleistocene</td><td>Upper</td></tr>
<tr><td>400</td><td rowspan="2">Middle</td><td>Middle</td></tr>
<tr><td>800</td><td>Lower</td></tr>
<tr><td rowspan="2">1800</td><td rowspan="2">Lower</td><td rowspan="2">Eopleistocene</td><td>Upper</td></tr>
<tr><td>Lower</td></tr>
</table>

In the Westeuropean framework, the Pleistocene is subdivided into the Lower one (about 1 Ma duration), the Middle one (more than 600 Ka) and the Upper Pleistocene (about 130 Ka). They are very different both in their duration and in their charcteristic events. The Stratigraphic committee of Russia subdivided the Pleistocene into two parts which are nearly equal in their duration (compared with the duration of the Piacenzian and the Gelasian stages of the Pliocene), but very different both in fauna and climate. The Eopleistocene or "the preglacial Pleistocene" had a comparatively short climatic cycles (about 40 Ka), meanwhile the Neopleistocene or "the glacial Pleistocene" is distinguished by more long (about 100 Ka) and contrasting climatic fluctuations which led to continental glaciations. The smaller subdivisions are distinguished both in the Eopleistocene and in the Neopleistocene: specific theriofaunal complexes are typical for each of them.

The Russian framework is more detailed than the Westeuropean one and more logical. It seems that just this framework may be taken for the base of the International stratigraphic framework (though not necessary with the terms used in it). This change could help to avoid the use of such terms as "the early Middle Pleistocene" which are using very often in the westeuropean literature.

AGE OF THE GLACIAL DEPOSITS IN THE AREA OF THE DNIEPEROVIAN GLACIER TONGUE

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The data on the Bryansk region, the North Ukraine and the nearest part of the Belarus show that the glaciolacustrine deposits overlying the upper till are substituted upwards in a section by the lacustrine-bog deposits with the typical Mikulian (Eemian) interglacial pollen diagrams, carpoid and diatom complexes. Such sections are known near the villages Smelyi, Losovka, Veliky (Great) Dvor [1], Kulegaevka and others. It is suggested that the upper till of the Dnieperovian glacier tongue was formed immediately before the Mikulian (Eemian) interglacial, i.e. at the end of the Middle Pleistocene, and is related to the same glaciation which upper till is spread near Moscow. This conclusion is proved by TL dating results (from 137 ± 24 up to 173 ± 43 Ka) received by V. K. Vlasov and O. A. Kulikov in the sections of glacial and fluvio-glacial deposits near towns Pochep and Klinzy. This is also proved by the data from the loess-soil formation which have been published by A. A Velichko with colleagues.

At the same time, the older till (or the pebbles which were formed due to its erosion) has been revealed in the same region. It is separated from the upper till by the interglacial deposits (village Budishchi and others) with the pollen diagrams typical for the Roslavlian (Muchkapian) interglacial (with two climatic optima). These deposits are correlated with the 4th interglacial of the Cromerian. That is why this till is related to the Donian glaciation which corresponds to the Glacial C of the Cromerian.

The facts on the regions located northernmore may show that the glaciation at the first half of the Middle Pleistocene (in the Russian stratigraphical framework) did not spread to the south of Tver and Yaroslavl, and during the Okian (Elsterian) stage, the glaciation boundary passed near town Roslavl [1].

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THE VEGETATION DURING THE SECOND HALF OF THE LATE PLEISTOCENE ON THE RUSSIAN PLAIN (33–17 KA).

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The paleofloristic materials from 96 sections of the Russian Plain for the Bryansk time and the Late Valdai have been combined in the palynological database. Analysis of the electronic maps made possible to study a temporal dynamics of distribution of indicator species of plants during the second half of the Late Pleistocene. The coenoses for the Bryansk Interstadial and Late Valdai glaciation were reconstructed from the north to the south of the Russian Plain.

The Bryansk Interstadial is the most significant warming of the last glacial epoch preceding the Late Valdai glaciation. The tundra and forest-tundra coenoses were considerably larger represented in the landscape structure than nowadays. Spores and pollen of Arctic and hypoarctic species such as Armeria, Dryas, Rubus chamaemorus, Alnaster fruticosus, Selaginella selaginoides, and Lycopodium apressum, reached 53–54° N. So the southern border of these taxa ranges was shifted approximately at 1200 km southward. Forest-tundra plants Alnaster fruticosus, Selaginella selaginoides, and Betula nana, were found in the southwestern Russian Plain and in Carpathians. This indicates an expansion of areas of microthermic plants in these regions. Further expansion of the Arctic flora to the south, for ~ 60° up to 47° N (or more than at 600 km) occurred in the Late Valdai glaciation. Northern taiga species ranges (Picea, Abies, Larix, Pinus sibirica) considerably expanded to the south, however, the continuous taiga zone did not exist. Probably it was the territories associated with highly dissected regions of the Russian Plain.

The presence of small amount of broad-leaved species in the forest communities have been established in the Neman, Valdai, and Moscow Uplands during the Bryansk Interstadial. Broad-leaved plants occurred in more appreciable quantities in the Dniester River basin, in the Podol and the Middle Russian Uplands, in the Donetsky Ridge, the Carpathians, and Crimea.

In the Late Valdai time, a further reduction of their ranges occurred. However, refugia of forest coenoses with broad-leaved species remained in the Dniester and Don River middle reaches, in the central part of the Russian Plain (49–51° N), in Moldova and near the Azov Sea. In the second half of the Late Valdai the representatives of steppe phytocoenoses were widespread over the whole territory of Eastern Europe and reached 62° N. In the north of the Russian Plain, steppe species were a component of tundra-steppe associations. Nowadays the similar plant associations occur fragmentary in northeast of Russia.

The reconstructed biogeographical provinces of Russian Plain show that in this time, the analogues of modern natural zones on the territory of the Russian Plain were absent. Late Pleistocene landscapes indicate the moderate cold climate of the Bryansk Interstadial and the cold and continental climate during the Late Valdai glaciation. Forest coenoses occurred fragmentary. They were mainly associated with the dissected territories with variable local habitats (uplands, mountain systems) and with the gullied relief. The distinctions between vegetation provinces were smoothed. The subarctic and steppe plants were represented practically everywhere. However, in contrast to the natural conditions of the Bryansk time, the Late Valdai maximum in the Russian Plain was characterized by a more extensive distribution of different types of periglacial forest-steppe and tundra-steppe landscapes.

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MIDDLE AND UPPER PLEISTOCENE STRATIGRAPHY OF VILNIUS AREA, EAST LITHUANIA

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The Middle and Upper Pleistocene sediment sequence investigated in Vilnius area is characterised by the dense net of more than 300 boreholes. For the interpretation of its structure the spatial (3D) digital model was compiled. The model is based on the data basis of bed spatial occurrence obtained from deposit stratigraphy. The results of litho- and biostratigraphy and the geological information on entire complex of erosion and accumulation processes served as main criterions for its compilation. After the preliminary model was compiled, it was tested under the results of palaeogeomorphological reconstruction carried out for the main interglacials. For this task the compilation of the vertical geological profiles of all the possible directions, the schemes and blockdiagrams of bed spread, surfaces and deposit parameter distribution related with geographical information system (GIS) was used. The digital spatial model with its visibility and flexibility actually served for the evaluation of Middle and Upper Pleistocene stratigraphy.

Till complexes of various age are notable for their different content of long distance transported crystalline rocks from Scandinavia, local Palaeozoic rocks (mainly Ordovician, Silurian, Devonian and Permian limestone and Devonian dolomite) and short distance transported Mesozoic rocks (marlstone, siltstone, sandstone, chalk). The Lower Pleistocene glacial deposits consist of till beds usually composed of a grey or brownish grey diamicton with a similar pebble composition. A greyish brown older till bed has, however, been observed in restricted areas in sheltered position in bedrock depressions.

Lake-margin sandy deposits, deltaic lithofacies and lacustrine bottomsets represent the transgressively rhythmic deposit sequence of Butenai (Holsteinian) palaeobasin indicated by pollen grain spectra from rare silt and clay beds and interlayers.

The Middle Pleistocene glacial sequence is composed of a very hard, brown diamicton of till beds with the same physical properties and petrographic composition. The subdivision of this glacial lithocomplex usually is related with the question of the existence of Snaigupele (Drente-Warthe) interglacial (Kondratiene, 1996). However the stratigraphical position of interglacial deposits and the results of recent dating in Valakampiai section (Gaigalas and Molodkov, 2001) rise doubts on its existence.

Lake sediment sequence of Merkine (Eemian) interglacial comprises a big variety of lithofacies including siliciclastic sediments of various grain-size, silty clay, lake marl as well as organogenic sediments with abundant mollusc shells. The pollen diagrams from interglacial deposit indicate the palaeobasin existence during all the interglacial time. The sequence stratigraphy displays permanent and regressively rhythmic character of sedimentation suggesting palaeobasin became shallower to the end of interglacial.

Late Glacial till beds composed of reddish brown and yellowish grey diamicton form the relief in the north-western part of investigated area.

NEW DATA ON VEGETATION OF UKRAINIAN POLESSIYE DURING THE MINDELIAN–RISSIAN INTERGLACIAL

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The development history of the vegetation of Ukrainian Polessiye during the Mindelian-Rissian interglacial has been reconstructed in detail (Artyushenko, 1967, 1973; Artyushenko, Arap, Bezusko, 1982). Zhytomyr Polessiye is the least studied part in this aspect. We have tried to fill the gap.

By results of palynological studies of the Mindelian-Rissian (Zavadivka) sediments in the key section nearby town Korostyshev, we reconstructed three development phases of the vegetation of Zhytomyr Polissia during Mindelian-Rissian interglacial.

Special features of the first phase are as follows: wide occurrence in pine and birch-pine forests with a presence of alder; nonsignificant share of desidious and thermophyllous species in forests, mainly *Tilia cf.cordata Mill.* and *Juglans spp.*

The features of the second phase may be formulated as follows: decrease of *Pinus* in composition of the forests, rise of the leaf species role, as well as their systematic diversity: *Alnus spp., Betula spp., Carpinus cf. betulus L., Tilia cf. cordata Mill,, Tilia cf. platyphyllos Scop., Quercus cf. robur L., Ulmus cf. laevis Pall, Corylus sp., Juglans sp.*; rise of a share of herbaceous associations, especially mesophyllous species, in the plant cover, as well as aquatic and coastal-aquatic plants.

The third phase is characterized by disappearance of *Juglans* out of forest assemblages, rise of the *Betula* role in their composition, evident decreasing of aquatic and coastal-aquatic plants in the vegetative cover, some spreading of Chenopodiaceae and Asteraceae areas.

The carried out studies testify that forests dominated within investigated territory during the Mindelian-Rissian interglacial. But their composition changed significantly depending on the climatic fluctuation during the studied period. General regularities and distinctive features of the Mindelian-Rissian interglacial vegetation of Zhytomyr Polissia and adjacent regions have been recognized.

THE ORIGIN AND DISTRIBUTION OF LOESS IN EUROPE: FOUNDATIONS FOR A STRATIGRAPHIC WORLD

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Loess is widspread in Europe, and it can been utilised in the investigation of palaeoclimatic variations. The idea of loess as a 'climatic register' originated with J. Hardcastle in New Zealand in 1890 but the development in Europe came with W. Soergel and his 1919 book. In the 1970s J. Fink and G. Kukla and co-workers and members of the INQUA Loess Commission worked to show that the European loess had major stratigraphic value and enormous palaeoclimatic potential. To fully utilise the stratigraphic information it is necessary to know something about loess as a materiasl; the loess ground contains the stratigraphic/climatic signal.

Smalley & Leach (1978) divided the European loess into two zones, and with some modification and updating their dichotomy still applies. There are two major sources of loess material (1) the northern glaciers which supply the 'nothern band' (2) the mountainous areas of the south. Smalley & Leach concentrated on the Alps but there are obviously sources in the Carpathians and other mountainous regions.

The Ukraine loess was involved in many disputes about origin and nature, but viewed on a continent-wide basis it appears to fit comfortably into the northern band. Glacial activity has provided classic loess which should relate to other deposits in the northern band (which stretches all the way over to Britain and Ireland). The southern loess settings are dominated by the Danube, and the transportation events are much more significant in the south than in the north. What stratigraphic impact this might have has not been determined.

Loess stratigraphy is possible because the loess is there; without loess material and loess deposits there is no message, no 'climate register', no stratigraphy. Somehow the loess, in the process of formation and deposition, preserves a climatic signal which we can subsequently interpret. There are intrinsic signals: information from particle size distribution, magnetism etc; there are first order derivative signals- the formation of palaeosols etc; and there are second order signals; the presence of snails, of vertebrate fossils etc.

If we look at the loess in East-Central Europe (the region defined by Smalley & Leach in their loess review of 1978) it is apparent that we have to consider both of the two main types of loess. It is possible that the difference is not climatically significant, but it deserves to be noticed and taken into consideration, in particular when comparative studies are being attempted. The study of loess in Europe has been complicated by national boundaries, a multitude of languages and some aggravating politics. Now that communication is fast improving it is possible to consider some continent wide studies. J. Fink set up the INQUA Loess Commission in the 1960s to produce an overview of loess stratigraphy in East-Central Europe- an aim that obviously complements the current SEQS endeavours. It can be demonstrated that there is interesting loess in at least 20 European countries- each one requires a national monograph. (The British Geological Survey is preparing the UK volume at this moment). Our other research priority is the stratigraphic connection across Europe- the Fink project enlarged and completed as a memorial to his vision and pioneering efforts.

LATE HOLOCENE SOIL FORMATION IN FLOOD PLAIN OF THE PARANA RIVER (SE BRAZIL): PALEOHYDROLOGICAL AND PALEOENVIRONMENTAL IMPLICATIONS

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Alluvial paleosol horizon from the 3–4 m bench of the Parana River was used to reconstruct the paleoenvironmental history and paleohydrological regime of the river. The bench consists of a Late to Middle Holocene sequence of sandy to silty clay layers of overbank deposits. A 10 cm horizon of paleosol at depth of 1.95 m is recognized elsewhere in the Upper Parana River flood plain.

Analyses of organic matter (total C, δ ^{13}C and humic/fulvic acid) palinology, magnetic susceptibility, micromorphology, X-rays difractometry and ^{14}C dating were processed in samples from two representative profiles of the study area.

Data characterized two phases in Late Holocene history of the river: 1) An older phase of stability in fluvial hydrology ("stasis") with low frequency of floods, produced good conditions for soil development (1700±70 ^{14}C years). This phase, with predominance of C_4 plants (open herbaceous vegetation) is interpreted as under lesser humidity than that in the present climate. 2) In a second phase, climate changed to the present conditions of humidity (annual rain fall of 1500 mm) with predominance C_3 plants (arboreal vegetation). Under this new hydrological regime (annual floods) river constructed an aggradational flood plain with depositional rate of $1.8 mm.y^{-1}$. The occurrence of levels of clay with predominance of Pteridophyta (*Alsophila, Blechnum, Botrychium, Cyathea*) pollens may be interpreted pioneer vegetation after anthropogenic forest clearing.

MEZIN LOESS–PALEOSOL COMPLEX IN BURIED BALKAS OF THE MIDDLE–RUSSIAN UPLAND

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Mezin loess-paleosol complex (LPC) is widespread in the Oka-Don plain. Its built-up reflects a complicated history of pedogenesis which includes Mikulinsky or Salynsky interglacial (Eemian), early interstadial (Krutitsky) of the Valday (Weichsel) glaciation and a transitional phase of syngenetic soil and loess formation in periglacial conditions.

In Middle-Russian plain, the Upper Pleistocene paleosols are preserved only in buried depressions of Eemian paleo-relief because of intensive denudation during the last climatic-erosional cycle. These soils are involved in a complex pedo-lithologic series: polygenetic pedocomplex formed after the the next-to-last glaciation and the following interstadial, and three soils related to early interstadials of the last glaciation separated by slope deposits.

A comparison of the Late Pleistocene LPC in the Oka-Don plain and in the Middle-Russian plain allows to make the following conclusions. Soils and sediments of trans-accumulative landscapes of uplands reflect an alternation of stages of landscape and soil evolution during glacial-interglacial cycles in more details. Mezin LPC which occurs in paleodepressions includes soils of two stages, and each shows the phases of its development. They are recorded in a type of pedogenesis and cryogenic and erosional-accumulative processes. Soil of Mikulinsky interglacial shows three phases of forest and forest-steppe pedogenesis, and two lithogenic phases when erosional processes prevailed. Transition to the last glaciation was followed by a catastrophic events: forest fires resulting in the accelerated erosion of interstadial soils.

Krutitsky stage includes three pedogenic phases when meadow soils were formed (Kukuevskaya, Streletskaya with ^{14}C-date ?58000 years ago and Alexandrovskaya), and three cryo-lithogenic stages when cryogenic and intensive geomorphological processes occurred. Bryansk palesol has been ^{14}C-dated to about 33000 years ago.

Mezin loess-paleosol complex demonstrates a complete cycle of development: from loess to a double-phased polygenetic soil. Mezinsky LPC has a complex but still unified profile in the plains of the North Eurasia. Within uplands, buried paleodepressions are widespread, with accelerated accumulationrates. Here Mezin LPC forms a thick pedo-lithological series which reflects an environmental rythms of a lower hierarchic range.

MARINE PLEISTOCENE OF THE PONTO–CASPIAN AND CORRELATIONS WITH MEDITERRANEAN ACROSS BLACK SEA STRAITS

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Connective straits are very important for a direct correlation between marine basins of different type: marine, demimarine, brackish and demifresh water basins. During the Last Interglacial, the Karangatian marine basin with the warmest water and the highest sea level (up to 8–10 m a.s.l.) occured in the Black Sea depression. The structure of marine terraces and bottom sediments, as well as U/Th dating, allow us to recognize 4 transgessive cycles with the following optima: Ashe unit – 140–145 ka; Karangatian s. str., Shahe (=Eemian) – 125 ka; Agoy – 100 ka; Sochi 80 ka. All of these units have been identified in the Kerch Strait. Two of them (Shahe and Agoy) penetrate into the Sea of Azov but only the Shahe unit goes further to the east, to the Manych Depression. Probably that provided a connection with the Caspian Late Khazarian basin. In the Sea of Marmara, the Late Thyrrenian (an analogous of the Karangatian) is represented by only one terrace in Kaplan-Tepe section, with U/Th date 120±4.8 ka. Regarding the U/Th age, other terraces assigned to Thyrrenian are much older: Yelken-Kaya (200±11 ka), Kaytaz-Dere (190±4.0 ka, 210±4.2 ka) and Altin-Ova (?250 ka). The latter corresponds to the Uzunlarian terrace of the Black Sea.

The terminal Late Pleistocene is represented by the New-Euxinian sediments with demifresh water fauna both in the Black Sea and in the Sea of Marmara. The recent drilling in the Central Bosphorus (between Tarabia and Beykoz) allowed to identify the New-Euxinian sands, 20 m thick, with mollusk fauna *Dreissena, Pontodreissena, Monodacna.* The ^{14}C age of this strata is from 26 ka at the base to 16 ka at the top. The Holocene of this core is represented by shelly mud with Ostrea and Mytilus (^{14}C age is 5.3 ka – 4 ka). The first appereance of marine fauna in the Sea of Marmara happened around 12 ka BP. In the Black Sea, the earliest marine fauna was fixed a bit later (ca 10–9 ka). After that, two modes marine connection through the Bosphorus start to function.

Caspian transgressions with brackish fauna impacted the Black Sea and the Sea of Marmara basins. For instance, at the beginning of the Middle Pleistocene, the Bakinian transgression with *Didacna* fauna penatrated through the Manych Strait to the Azov and Black Seas (Chauda basin). The Chaudian mollusk complex with *Didacna pseudocrassa* reached the Sea of Marmara and the Dardanelles where it was found in the Gallipoli section.

EARLY MIDDLE PLEISTOCENE SEQUENCES AND STRATIGRAPHY IN RUSSIA AND WESTERN EUROPE

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The early Middle Pleistocene was one of the most significant periods in Quaternary history, in terms of climatic, environmental and evolutionary change. Climatically it marked the transition to dominance of the Earth's orbital regime by 100,00 year Milankovitch ellipticity cycles instead of 41,000 year obliquity cycles. It also heralded the major glacial episodes in which ice sheets invaded temperate latitudes of northern Eurasia. Furthermore, reinvestigation of the ocean floor sedimentary and isotope record (Bassinot et al. 19) has revealed the existence of additional and more complex climatic cycles in this part of the stratigraphical record than had originally been recognised in the numbered sequence of Marine Isotope Stages (MIS).

It has become clear that classic stratotype sequences of the Cromerian in Eastern England and the 'Cromer Complex' of the Netherlands and additional sites in Germany and Denmark represent only fragments of this record, which are difficult to correlate either betwenn themselves or with the deep ocean record. In Russia, particularly in the upper Don Basin, but also in Belarus and Poland, deposits of early Middle Pleistocene age are well represented. In particular, the Don Basin contains richly fossiliferous fluvial sequences, where superposition of terrace deposits and the occurrence of the Don Till as a marker horizon across the basin make the stratigraphic position a good deal clearer. Nevertheless, because these are fluvial deposits, the sequences are full of unconformities, so that it is not always clear which substages of interglacial/glacial cycles are present and what is missing. Only thick sequences of lacustrine deposits laid down on the deglaciated surface of the Don Till yield more or less continuous records, primarily palynological, through successive cycles - but, of course, only relating to the upper part of the Don succession.

Correlation between western and eastern Europe requires detailed palaeontological studies, supported wherever possible by palynological and sedimentological evidence. Small vertebrate and perhaps mollusc faunas appear to provide the best opportunities, but for this to be successful, joint investigations and taxonomic agreement between specialists in different countries is of fundamental importance. The apparent correlation of the Don glaciation with MIS 16 also provides an important marker horizon, for which confirmation is being sought through palaeomagnetic studies.

MODERN TRENDS OF GEOLOGIC INVESTIGATION OF THE QUARTERNARY DEPOSITS

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The climatic principle of periodization and stratification of the Quarternary formations including loess-soil strata is generally recognized now. It is obvious that climatic changes had epicyclic nature and, thus, were, in general, synchronous.

Nevertheless, it is rather widespread, the opinion that in practice, the problem of age identification of stratigraphical horizons on the basis of climatic conditions is extremely difficult or completely unsolved. Such arguments are proposed to prove this opinion:

1. The climatic conditions of warm (or cold) stage essentially change laterally according to climatic zonality and other factors. Correspondingly, the characteristics of stratigraphical units (stratigraphical equivalents of palaeoclimatic stages) also should essentially differ depending on zonal distribution of geological sections. On this basis, the conclusion is made that correlation of the coeval stratigraphical units by palaeoclimatic indices is possible only for small distances, whereas between the distant regions, it is extremely hindered or completely impossible.

2. As a rule, the formation of properties of stratigraphical units takes place also under influence of local factors, for instance, hydromorphism, hillside processes, etc. They distort the characteristics of stratigraphical unitns, including those caused by climatic conditions. Therefore, the possibility of the stratigraphical identification of stratigraphical units by their climatic characteristics should depend on a spectrum of local factors. Each of these arguments is enough just and, apparently, demonstrates essential restriction of the palaeoclimatic method of correlation.

Nevertheless, the problem has its solution. The above arguments have a principal significance only in a definite context, but they lose a significance in conditions of other methodological approach. The major principle of such approach is based on the fact that the ratio of palaeoclimatic conditions of two adjacent stages is an invariable value. In any point of polar, moderate or equatorial zones, a cold stage will be more cold as compared with the preceeding and following warm stages. As far as stability of such ratio is peculiar value not to only adjacent stages, but also to "each stage to each stage", we have a rigid system of invariable values. In geological sections, such a persistence of characteristics of climatic conditions of different age stages is reflected through invariance of a ratio of characteristics of the corresponding stratigraphical units.

"The Scheme of the Detailed, Stratigraphy of Palaeogeographical Stages of the Quaternary and Pliocene of Ukraine" is used in Ukraine for paleogeographical and stratigraphical investigation of the Late Cenozoic. It represents a rather detailed model of palaeoclimatic stages concerning both a sequence and a range of the stages, and reflection of palaeoclimatic conditions of these stages. Investigation of a ratio of parameters of palaeoclimatic stages in their natural sequences have revealed their objective nature. The climate changed not accidentally but according to the definite regularities, that have their reflection in the facial-stratigraphical structure of sections.

The "Scheme... " and the palaeogeographical principle of relativity and regularity of stage-by-stage development of climate are main components of the palaeogeographical approach. In context of this approach, the complex of "zonal and facialy independent" methods of investigation and correlation of the Quarternary and Pliocene formations has been elaborated. It allows not only essential supplementation of traditional methods, but also demonstrates an independent value as a powerful tool of stratification of sections, interregional and "interfacial" correlation.

INTERREGIONAL CORRELATION OF LOESS–SOIL–CRYOGENIC AND GLACIAL SERIES OF THE EAST EUROPEAN PLAIN

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Long-term studies of loess-soil-cryogenic series and glacial sequences in various regions of the East European Plain permitted to develop a refined version of the Pleistocene stratigraphy and to visualize the order of climatic macrocycles (interglacial – glaciation) in Eastern Europe through the last ~0.8 Ma.

At least three macrocycles are distinguished on the East European Plain during the **Early Pleistocene**. In the southern part of the plain there are composite soil complexes typical to recent sub-Mediterranean landscapes dated to warm intervals (interglacials); in the north they are commonly destroyed by subsequent erosion. Cold intervals were marked by widely spread ice sheets, the last of which (the Don glaciation) was the most expansive of the Pleistocene glaciers. Loess horizons developed in the periglacial regions; they display distinct traces of cryogenic deformations, attributable mostly to seasonal freezing, or to freezing at the southern periphery of the permafrost area.

As for the **Middle Pleistocene**, no more than two climatic macrocycles of that kind are recognized in most regions by now. At the interglacials a major portion of the territory (including southern regions) featured forest and steppe soils typical of subboreal soil formation. Environments that existed during the first cold interval (between the Likhvin and Kamenka Interglacials) are not sufficiently known at present. It is likely that the ice sheet did not reach the central regions at that time, in spite of severe climate. The latter is indicated by large enough frost wedges of that age found immediately south of Moscow. The main glaciation of the Middle Pleistocene – that is, the Dnieper one – was preceded by the Romny warming; conditions of soil formation at that interval, at least in central regions, were essentially different from typical interglacials. The Dnieper glaciation which included the Moscow stage was the most expansive during the Middle Pleistocene; the authors correlate it with stage 6 of the oxygen isotope scale. In periglacial regions this cold interval corresponds to a thick loess horizon, including a few levels of large ice wedge pseudomorphs and interstadial fossil soils.

Only one macrocycle was identified in the **Late Pleistocene**; it has been the subject of extensive research which provides a means for a detailed correlation of events in the glaciated region with those in periglacial zone within an interval of 140 to 10.3 ka BP. In the southern and central regions of the plain the warm interval (that is, the Mikulino interglacial) is presented by a paleosol attributed to the Salyn phase of the Mezin soil complex (subboreal soil formation); it is correlated with oxygen isotope stage 5e. As for the cold phase of the macrocycle, it corresponds to the complex Valdai glacial epoch. It should be noted that in spite of modest expansions of the Valdai ice sheet (in comparison with older glaciations), the climate of that time was the most severe one of the whole Pleistocene, with highest degree of continentality. Such were conclusions drawn from studies of loess, cryogenic features (the largest ice wedge pseudomorphs were up to 5–6 m in vertical dimension), and interstadial soils (Bryansk and Krutitsa paleosols). The Bryansk soil formed in tundra-steppe environments, and Krutitsa one formed in cold steppes.

DIAGNOSTICS OF THE MIDDLE AND LATE PLEISTOCENE SOIL FORMATION IN THE CENTRAL EAST EUROPEAN PLAIN

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Variations in heat and moisture supply during the Pleistocene interglacials determined differences in the soils formation direction, zonal pattern of soils, environments of sedimentation and lithogenesis. In the course of a climatic macrocycle hydrothermal conditions varied over such a wide range that soil formation in the central part of the East European Plain changed from arctic one at the onset of warming to subboreal at the interglacial optimum and back to arctic typical of the cold phases of macrocycles. Some intervals of milder climate during glacial epochs were marked by formation of interstadial soils. Typically, interstadial soils feature syngenetic cryogenic formations.

The best known is the last (Late Pleistocene) macrocycle consisting of a warm interglacial (Mikulino, Eemian) epoch and the Valdai glaciation, both changes in climates and environments and evolution of soil formation being thoroughly investigated. At the thermal optimum of the macrocycle (that is, the Mikulino optimum, 125 ka BP) subboreal clay differentiated soils developed in the central portion of the East European Plain under broad-leaved forests of western type (with a sizeable proportion of hornbeam). In the Oka drainage basin the soils featured a distinct A2 horizon, the dominant soil-forming process was lessivage. South of 53°30'N humus formation was of primary importance, though signs of lessivage are still noticeable in the lower part of soil profile. During the cold half of the cycle, with a thick ice sheet spread in the northwest of the Plain and loess accumulating in the central and southern regions, a few phases of somewhat milder and warmer climate are recorded. The warmest were the Krutitsa (65 to 54 ka BP) and Bryansk (32 to 24 ka BP) interstadials. North of 54°N the Bryansk soil have some features in common with modern cryozems, and their profile is carbonateless. South of this latitude gleyization is less evident, while a horizon of carbonate accumulation appears in the profile.

As for the Middle Pleistocene, there are two complete climatic macrocycles distinguished within this interval, the younger one including the Dnieper glaciation with the Moscow stage.

The older Middle Pleistocene macrocycle includes the Likhvin Interglacial and Kaluga cooling (Pechora glaciation). The Inzhavino paleosol corresponds to the Likhvin optimum; in the central part of the East European Plain the latter featured subboreal conditions, and the soil developed under broad-leaved forests. It is distinguished for a conspicuous differentiation along the profile (of eluvial-gleyic type). South of 52°N the eluvial horizon is not pronounced morphologically, while siallitization signs are more distinct. The soil here is not unlike brown forest lessive ones. The younger Middle Pleistocene macrocycle includes the Kamenka interglacial and the Dnieper glaciation; a lobe of the Dnieper ice sheet penetrated along the Dnieper valley as far south as 48°30'N. The loess-soil-cryogenic series bear indication of a few stages of relatively milder climate during the glaciation which resulted in initial gley soils (Romny, Kursk soils). At the Kamenka interglacial optimum, soils with a morphologically distinct eluvial horizon are found only north of 55°N. Farther south, in addition to active lessivage and some siallitization, a thick horizon A1 being developed. South of 52°N any signs of lessivage are seen only in the lower part of soil profiles.

On the whole, the soil formation process cyclicity during the Middle Pleistocene was similar to those recorded in the Late Pleistocene and is seen in the Holocene soils. Available data on the loess-soil series suggest that the same tendencies in the soil evolution were typical for the Early Pleistocene as well.

PALEOMAGNETIC SECTION AND MAGNETIC PROPERTIES OF QUATERNARY DEPOSITS OF THE VIAZIVOK SITE

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A detailed study has been carried out of a 55 m thick sedimentary sequence of one of the most complete geologic sections of the Quaternary of the Middle Dnieper area. The section includes almost all Pleistocene units (with exception of the Dofinivka and Prychernomorsk ones). Totally, 235 stratigraphic levels were tested.

The rocks studied show the following magnetic parameters. The NRM values (Jn), magnetic susceptibility (χ) and the parameter Q vary as follows:

$$Jn = (1{,}2 \div 65{,}0) \cdot 10^{-3}\ A/m; \quad \chi = (5 \div 107) \cdot 10^{-3}; \quad Q = 0{,}2 \div 4{,}3.$$

A clear dependence of the Jn and χ values on the lithological composition of the sediments is observed. As a rule, higher values of these parameters are observed in fossil soils and lower ones in the loess units.

A differential thermomagnetic analysis has shown that grains of magnetite and iron hydroxide are the main magnetization carriers in the rocks studied. To separate the primary remnant magnetization vectors, a thermal cleaning in the regime of 200, 250 and 300°C was used with heating in a zero field for an hour, as well as alternating field cleaning in the tension interval from 2,5 to 60 mTl.

The analysis of behaviour of the vectors of primary remnant magnetization of the rocks studied allows to determine the zones with normal, reversal and anomalous magnetization. It is shown that the formation of the main sediments thickness occurred during the time interval corresponding to the Brunhes epoch of geomagnetic polarity. Within this interval in the section studied, only one short-time event took place recorded by anomalous magnetization of the loesses of the Dnieper unit.

The lower part of the section (clay loams of the Shyrokyno unit and sands of the Kryzhanivka unit) has a reversed and anomalous polarity which corresponds to the Brunhes – Matuyama boundary. This can be used as a benchmark for a stratigraphic subdivision of the Pleistocene deposits in the Middle Dnieper area.

SMAGNETOSTRATIGRAPHY OF PLIOCENIC – PLEISTOCENIC SEDIMENTS OF THE MIDDLE NEAR – DNIEPER REGION.

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In two sections of a loess formation of the Pliocene-Pleistocene age, paleomagnetic research of a sequence 35 meter thick was carried out. The sections almost completely represents the Pleistocene, Upper Pliocene, and partly Middle and Lower Pliocene.

The paleomagnetic section has been set up which comparison with the Cox's scale and the paleomagnetic scale of the Pleistocene of Ukraine suggests the following:

1. The studied sedimentary rocks of Pliocene – Pleistocene age formed in the Middle Dnieper region in the epochs of geomagnetic polarity Brunhes, Matuyama and Gilbert.

2. In both sections, the boundary between the Brunhes and Matuyama epochs has been establishes in the fossil soils of the Shyrokino unit.

Besides, against the background of normal polarity of Brunhes epoch, the events of inverse polarity have been established: the Kargapolovo event – in fossil soils of the Vytachiv horizon, the Dnieper event – in re-deposited till of the Dnieper unit and the Y-zone – in the Lubny horizon.

These events may serve as a benchmark in subdivision and correlation of the Pliocene-Pleistocene sediments in the Middle Dnieper region.

PECULIARITIES OF QUATERNARY SEDIMENT STRUCTURE AND COMPOSITION AT THE SOUTH–EASTERN EDGE OF MIDDLE–RUSSIA UPLAND

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We studied the Quaternary key section in the Stoilensky iron-ore quarry which allows to correlate the key-sections of Don area and the type sections of Central Russia and Ukraine. The depth of the section is 220 m. The 60-m continental sequence include 5 sedimentary strata of different age and origin which consist of 20 layers.

1 sedimentary stratum consists of multicolored clays of a basine sedimentation overlying the Cretaceous rocks. The heavy fraction of terrigene minerals is composed by staurolitite-disthene-tourmaline association with significant rutile component.

2 sedimentary stratum consists of lacustrine-alluvial deposits. Well-sorted sands and sandy loams with calcite concretions are abundant.

3 sedimentary stratum consists of reddish-brown subaerial deposits with three buried soils. It is mineralogically characterized by tourmaline-disthene-staurolitite association and inherit the quantitative and qualitative features of underlying reddish sands. The abundance of ferric oxide minerals expresses the active weathering of these subaerial deposits, which terminate the pre-Pleistocene sedimentary stage.

4 sedimentary stratum, overlying the pre-Pleistocene sediments, consists of lacustrine-glacial and moraine-like deposits. The separate rock blocks and glasiodislocations are presented. Staurolitite-ilmenite-disthene association are abundant, and the garnet, hornblende and epidote are presented. The main features of these deposits reflect its glaciolgenic origin and probably belong to the Don stage.

5 sedimentary stratum consists of pale-brown loess-like clayey loams with 4 well-defined buried soils. It is TL-dated to 185±47 KA BP (RTL-811) that fix the boundary of early Middle Pleistocene early-stage loess sedimentation.

The interdisciplinary studies of this unique section of the Stoilen quarry allows to solve the present stratigrathic and paleogeographic problems, such as marker-layers correlation, lithogenic studies, the boundaries of maxim glaciation time and the paleoclimatic trends. This allows to consider the Stoilen section as stratotypical.

STRUCTURE OF THE TERRACES OF THE DNIEPER MIDDLE REACHES AS ONE OF CRITERIA OF INTERREGIONAL CORRELATION

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The Middle and Late Pleistocene valley of the Dnieper is situated within the Dnieper graben, south-western slope of the Dnieper-Donetsk Depression /DDD/, Ukrainian Shield /US/ and its north-eastern slope.

The Vth (above the flood-plain) terrace is the main marker for study of the succesion of the Middle Dnieper terraces. It consists of a complex of glacial, lacustrine- and glacio-fluvial formations of the Dnieper stage of the Middle Neopleistocene which is correlated by us with the 8th stage on the oxygen-isotope scale. In the lower part of the profile of this terrace, the 1–4th alluvial suites of the Zavadivka stage (according to the palaeontological data it is correlated with Holstein, 9–11th isotopic stages) are bedded. The height of this terrace above the Dnieper water level is 50–65 m, its width reaches 85 km. According to the latest data, the Vth (above the flood-plain) terrace has two morphologically marked levels, the lower of which we correlate with the Potyagailivka and Dnieper stages (9–8th stages on the oxygen-isotope scale).

Within the Dnieper-Donetsk Depression /DDD/, the Vth (above the flood-plain terrace) overlies the more ancient buried VIth (above the flood-plain) terrace (Lubny – Tyligul) with the alluvium corresponding to the 12–15th isotope stages. Southenmore, near Kremenchuk town, the VIth (above flood-plain) terrace is morphologically identified. The glacial exaration was widespread in the northern part of the area that flattened the levels of terraces into a single plain.

The IVth (above flood-plain) terrace is not widely spread in the area. Its large relics occur at the Dnieper left bank by Kyiv, Kaniv and Cherkasy. Its height above the Dnieper water level is 40–45 m. Two suites are well observed in the alluvial profile of the terrace: the lower suite that was formed at the Kaydaky interglacial (7th isotope stage) and the upper suite that was probably formed at the cold Tyasmyn period (6th isotope stage). In the area of the Kaniv town, within the Shevchenkivsky depression of the glacial exaration, the terrace alluvium overlies the Dnieper lacustrine-glacial deposits. The IIIrd (aboveflood-plain) terrace is widespread (up to 40 km wide), its height above the Dnieper water level is 30–35 m. There are two distinct suites in the alluvium composition. The lower suite was formed at the Pryluky warm interglacial stage (isotope stage 5e), the upper suite was formed in the Uday cold stage (isotope stage 5d). Within DDD, it is sometimes overlain by the more young periglacial Bug alluvium (constrative type of alluvia accumulation).

Compared with the IIIrd (above flood-plain) terrace, the II (above flood-plain) terrace (Vytachiv – Bug) is more narrow, its height above the Dnieper water level is 20–25 m. In the complete sequences, the fluvial deposits are represented by the Vytachiv alluvium (isotope stage 5c-a) at the bottom, and by the Bug alluvium (isotope stage 4) at its upper part.

The Ist (above flood-plain) terrace is not large but occurs rather often . Its height above the Dnieper water level is 10–15 m. The profile of the terrace is mainly represented by the Dofinivka – Prychornomorsk alluvium (isotope stages 3 and 2). Near Kyiv, the terrace has three morphological levels and is composed by sandy deposits.

The II – VIth (above flood-plain) terraces of the Middle Dnieper in the northern part (Polissia) have mainly sandy composition of their cover that changes into a soil-loess cover to the south. The analysis and stratification of the subaerial cover on the palaeopedological basis, together with the morphological features of the terraces and palaeontological and

palaeomagnetic data, form the main instruments for the recognition of the river terraces and for stratification of alluvium, correlation with the oxygen-isotope scale. The height of the terraces and the thickness of alluvium (with the neotectonic characteristics taking into account) are the most important criteria for such comparison and interregional correlations.

THE DOMURATY POLLEN SUCCESION – VEGETATION AND ITS STRATIGRAPHICAL POSITION IN THE MIDDLE PLEISTOCENE OF NORTHEASTERN POLAND

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Geological works carried out in 1998 at the sheet Sztabin of the **Detailed Geological Map of Poland** at scale 1:50 000 included drilling of a test-cartographic borehole at Domuraty. The borehole was located in the Bialystok Upland, near its northern slope and to the south of the Biebrza River Valley.

The sedoments from a core have been investigated by the pollen analysis (fluvial-lacustrine-boggy series) and by the petrographic analysis (tills).

The Pleistocene formation in this section starts with tills of the Menapian (Narevian) and the older Elsterian (Nidanian) Glaciations. The next till represents the younger Elsterian (the older stadial of the Sanian) Glaciation. In total, these tills are about 35 m thick. The lithotypes of the Narevian and the older stadial of the Sanian Glaciations (in contradistinction to lithotypes of the Nidanian Glaciation) were characterized by a predominance of contents crystalline rocks over northern limestones and high contents of the local rocks (for example – on the average 27% of the local siltstones). The red clay complex, about 3 m thick, separated these tills from fluvial-lacustrine-boggy deposits, about 40 m thick.

The pollen diagram from the Domuraty section represents a sequence of four temperate periods with the forest development separated from one another by cold periods. At the began of the first period main components of forest were *Pinus* and *Betula*. The occurence of *Picea* and *Larix* pollen indicates their important share in pine-birch forest. The increase of pollen values of *Quercus, Ulmus, Tilia, Corylus* and *Alnus* reflects the development of mixed forest, which changed into boreal coniferous forest with domination of *Picea* and *Pinus* at the end of this period.

The second warm period is evidenced by expansion of pine-spruce forest with the distinct proportion of *Betula* and small admixture of more warmth-demanding components – *Quercus, Tilia* and *Corylus*. Alder forest with *Ulmus*, *Fraxinus* and *Salix* prevailed in wetter habitats. The vegetation of the youngest, fourth period has similar character, except the less proportion of Picea in forest communities.

In the third warm period reforestation started with expansion of *Betula*, later *Pinus*. The increasing proportion of *Quercus* and *Ulmus* pollen evidences changes in pine – birch forest. The beginning of the continuous *Carpinus,Alnus, Picea* and *Abies* curve signals the rising role of these trees in forest. The presence of warm-loving components such as *Tilia, Acer* and *Azolla filiculoides*, *Salvinia* is distinct. The period ended spreading of *Pinus* and *Betula*.

Characteristic features of the cold periods are the very high values of NAP with the domination of Poaceae and Cyperaceae pollen, the presence of heliophytes such as *Artemisia, Ephedra* and *Chenopodiaceae*. This phenomenon reflects the appearance of open vegetation – cold steppe. The occurence of *Betula* and *Betula nana* typ pollen might suggests the existance of the tundra-like vegetation.

The pollen succesion from the Domuraty section differs from the pollen succesion distincted in Poland and the temperate periods present interstadial character of vegetation.

The lacustrine sediments are overlain by four tills. The lithotypes of these tills are characterized by superiority of contents northern limestones over crystalline rocks and little

contents of the local rocks (below 10%). Stratigraphically they could be correlated with: the Saalian (Liviecian, Odranian , Wartanian) and the Weischelian (Vistulian) Glaciations.

The geological situation, results of the pollen analysis and petrographical studies suggest the Middle Pleistocene age for the lacustrine series from Domuraty. Moreover the characteristic features of pollen flora indicate its position in the lower part of the Middle Pleistocene. The fluvial, lacustrine and boggy sediments, contained the pollen succesion, are younger then till of the older stadial of the Sanian Glaciation. Therefore these sediments might be accumulated in the warm interval between the the older and younger stadials of the Sanian Glaciation.

NEW DATA FROM THE LATE PALEOLITHIC TYPE LOCALITY "BAJSLAN–TASH CAVE" (SOUTHERN URALS)

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Bajslan-Tash cave situated along the latitude current of the Belaya river in the southern extremity of the Ural mountains. Thickness of the loose eluvial-deluvial deposits at the entrance of the cave is about 3 m. Biostratigraphical sampling (each 15–20 cm) of cave's deposits was done in 1999–2000, simultaneously with archaeological excavations (V. G. Kotov, Ufa). The following deposits formed this section from top to bottom. Upper Holocene 1. Brown-gray loam with limestone rock debris (0,4 m). 2. Dark-gray loam with limestone rock debris and ash coal, GIN [1] 10852 1600±50 y (0,95 m). The Lower-Middle Holocene 3. Brown-gray sandy loam with limestone rock debris, GIN [1] 10854 7140±170 y. (0,9 m). The Upper Neopleistocene (Ostashkovo) 4. Brown loam with limestone rock debris and blocks, GIN 10853 13560±250 y. (2,25 m). In the middle part of this layer the artifacts of "final Paleolithic" were founded.

Mollusks. The Late Neopleistocene mollusks complex: *Vallonia costata, Chondrula tridens, Goniodiscus ruderatus, Euomphalia strigella.* The Early-Middle Holocene mollusks complex: *Succinia oblonga, Cochlicopa lubrica, C. edentula columella, Vallonia costata, Chondrula tridens, Goniodiscus ruderatus, Bradybaea fruticum, Euomphalia strigella, Ancylus fluviatilis, Anisus spirorbis*. The Middle Holocene mollusks complex: *Cochlicopa lu-brica, Vallonia costata, Chondrula tridens, Retinella hammonis, R. nitens, Bradybaea fruticum, Euomphalia strigella.* The Late Holocene mollusks complex: *Succinia oblonga, S. putris, S. sp., Cochlicopa lubrica, Columella edentula, C. edentula columella, Pupilla muscorum, Vallonia pulchella, V. costata, Chondrula tridens, Goniodiscus ruderatus, Retinella hammonis, R. nitens, Euconulus fulvus, Bradybaea fruticum, Zenobiella rubiginosa, Euomphalia strigella, Radix ovata, Ancylus fluviatilis, Anisus spirorbis, Gyraulus sp., Unio sp., Pisidium amnicum, Dreissena sp.*

Small mammals. The Late Neopleistocene small mammals complex: *Microtus gregalis, Lagurus lagurus, M. oeconomus, Sorex sp., Ochotona sp., M. agrestis, Clethrionomys ex gr. glareolus-rutilus, M. arvalis, A. ex gr. uralensis-agrarius, Arvicola terrestris, Chiroptera, Cricetus cricetus, M. ex gr. arvalis-agrestis, Allocricetulus eversmanni, Cricetulus migratorius, Apodemus uralensis, Ellobius sp., Crocidura sp., Sicista sp., Mustela nivalis, Lepus sp., Talpa sp., Erinaceus sp., Citellus sp., A. flavicollis, Cl. rufocanus, Eolagurus luteus, Mustela erminia.* The Early-Middle Holocene small mammals complex: *Microtus gregalis, Lagurus lagurus, Ochotona sp., M. arvalis, Clethrionomys ex gr. glareolus-rutilus, M. oeconomus, Sorex sp., M. agrestis, Apodemus ex gr. uralensis-agrarius, Chiroptera, Ellobius sp., Arvicola terrestris, Cricetus cricetus, A. uralensis, Cricetulus migratorius, Allocricetulus eversmanni, M. ex gr. arvalis-agrestis, Sicista sp., Mustela nivalis, Talpa sp., Crocidura sp., Lepus sp., Citellus sp., A. flavicollis, Cl. rufocanus*. The Late Holocene small mammals complex (species are enumerated in accordance with decreasing of their remains part in the whole collection): *Clethrionomys ex gr. glareolus-rutilus, Microtus gregalis, Chiroptera, Sorex sp., M. arvalis, Lagurus lagurus, M. oeconomus, Apodemus ex gr. uralensis-agrarius, Ochotona sp., M. agrestis, Ellobius sp., M. ex gr. arvalis-agrestis, Cricetus cricetus, Arvicola terrestris, A. uralensis, Cricetulus migratorius, Talpa sp., Mustela nivalis, Cl. rufocanus, Crocidura sp., A. flavicollis, Allocricetulus eversmanni, Lepus sp., Sicista sp., Allaclaga major, Eolagurus luteus.*

Species compositions of fauna of different age is practically the same, but in the Late Holocene fauna *Clethrionomys* are predominated (30%), in the Early-Middle Holocene and Late Neopleistocene fauna *Microtus gregalis, Lagurus lagurus, Ochotona sp.* are predominated (in the Late Neopleistocene, *Microtus gregalis* is 40%). During the sedimentation of the loose eluvial-deluvial deposits in the area near the cave, forests and meadows biotopes reduced, steppe areas increased.

Large mammals. Bone remains had been determined by P. A. Kosintcev (Ekaterinburg). The main part in the collection is presented remains of *Capreolus pygargus, Ovis aries et Capra hircus, Ovis aries, Lepus sp. and Castor fiber*. The roll of small Mustela remains is large. *Equus caballus, Alces alces, Marmota sp.* are usual species. Remains of *Canis lepus, Canis familiaris, Ursus arctos, Meles meles, Bos taurus, Rangifer tarandus* are rare. Complex of main species from different horizons is identical. There are no extinct species in the fauna composition. The whole fauna composition is of the Holocene age.

Vegetation. In accordance with palinological data (L. I. Alimbekova, Ufa) of end of the Late Neopleistocene, meadow-steppe associations were predominate. In the Early-Middle Holocene time, forest-steppe conditions existed. At the beginning of the Late Holocene time, mixed ~~broad~~-leaf-coniferous forests with meadow-steppe (open woodlands) predominated.

Bajslan-Tash cave locality in the Southern Urals region is the single ~~at~~ the present~~ily~~, ~~location~~ the postglacial stage of natural environment and human development. Excavations of the cave will continue in 2001–2002, and new interesting data will be obtained.

Now the radiocarbon dating is a problem, so we invite all specialists interested in collaboration.

MIDDLE PLEISTOCENE DEPOSITS OF UKRAINE IN THE SECTIONS GUTA AND TUR

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The sediments of the sections 5537 near village Guta and 5517 near village Tur (Ratnov area of the Volyn region) were described by B. Vozgrin in 1991. Correspondingly 26 and 98 samples were palynologically studied from both sections. In the sections, the lacustrine deposits are of most interest: from the depth 6,4–7,2 m (Guta; humus sands) and 18,4–29,2 m (Tur; from top to bottom: silt, peat, silt, loam), with the spectra of an interglacial type.

In the humus sands of Guta section (the depth 6,4–7,2 m), AP dominates (98–100 %) with a small portion of NAP (1–7%) and spores (1–3 %). In AP, *Pinus* prevails (80–93%), *Betula* values (arboreal forms) are low (1–14%), and single grains of *Alnus* and *Quercus* occur. The *Polypodiaceae* spores are common. The interval is subdivided into two subcomplexes (a and b) by the NAP content (up to 7 %), by presence of *Larix, Picea, Tilia, Nyssa, Corylus, Chenopodiaceae, Artemisia, Dipsacaceae, Polygonaceae, Ericaceae, Lycopodium inundatum, Sphagnum, Fossombronia* in the lower one (à), and by increase of a role of Betula (10–14%), Abies (up to 5%) in the upper one (b). This reflects the different palaeogeographical phases during the period of sedimantation: firstly pine forests dominated which include spruce, larch and some broad-leaved species, later pine-birch forests were spread with some fir. The absence of a large amount of exotics in the flora composition does not allow to relate it to the Early Pleistocene. The presence of *Tilia tomentosa, Quercus pubescens* enables to consider the flora as the Middle Pleistocene one and namely – to the final stages of the Kaydaky (Sklov) interglacial.

In swamp-lacustrine sediments (section 5517, Tur (loam, silt with a peat interlayer) on a depth 18,4–29,2 m, a rich palynoflora is detected, consisting of 13 palynocomplexes (PC). Firstly (PC-1) the maximum of the broad-leaved species took place (49–54%), *Quercus* (29–31%) and *Tilia* (11–14 %) dominated. There was a lot of *Ulmus* (8–9%), Corylus (10–12%), *Alnus* (7–13%), *Picea* (7–14%), *Abies* (0,5–5%). PC-2 is marked by an increase of *Betula* (33%), *Pinus* (19%), though the high values of *Quercetum mixtum* (31%, *Quercus* – 22%), of *Picea* (11%) and *Abies* (3%) still are observed. Later (PC-3), the further increase of *Pinus* (52–57%) took place whereas *Quercus* (19–22%) was most abundant among broad-leaves species. Then, in PC-4, the maximum of *Betula* (14–30%), *Alnus* (8–13%) and *Carpinus* (13–29%) is registered. In PC-5, peaks of *Alnus* (4–14%), *Quercus* (21–23%), *Ulmus* (9%), and *Corylus* (4–9%) are observed against the background of *Pinus increase* (33–49%). For PC-6 the maximum of *Pinus* (67%), *Quercus* (22%), *Tilia* (8%) and *Ulmus* (10%) is characteristic, whereas for PC-7 – of *Alnus* (28%), *Tilia* (6%), *Carpinus* (40%), *Corylus* (17%).

In PC-8-10, the high values of *Pinus* (16–64%), *Alnus* (1–22%), *Carpinus* (5–33%) and occurrence of the dark-conifers genera were marked: *Picea* (1–7%), *Abies* (1–3%). In PC-11, the predominance of *Pinus* (56–89%) with the constant participation of *Picea* (1–5%), *Abies* (1–3%), and later (PC-12), of *Betula* (34–43%) is observed. PC-13 includes much *Pinus* (62%). Judging from the compositions of exotic forms in this flora (*Quercus pubescens, Tilia tomentosa, Zelcova* (?), as well as presence of Abies and Picea at the beginning of the interglacial, final phases of a climatic optimum and at the end of the interglacial, the age of the studied deposits is determined as Zavadivka (Alexandria, Likhvin) interglacial.

TEMPERATURE AND PRECIPITATIONS AT THE LATE GLACIAL AND HOLOCENE OF BELARUS (BY PALYNOLOGICAL DATA)

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Paleoclimatic reconstruction for the last 13000 years for the territory of Belarus are carried out for the sections of different parts of its area.

At the Late Glacial time (13900–10300 yrs), at the cold stadial snaps DR-I (12700–13000 yrs), DR-II (11800–12300 yrs) and DR-III (10300–10800 yrs), the climate was cold and dry, temperature of July was lower than modern one on 1–3°, January – on 4–7°, a year – on 2–5°, precipitation was lower than modern on 75–120 mm; at the interstadials BL (12300–12700 yrs) and AL (10800–11800 yrs), the climatic conditions were improved, the climate became moderately-cold and humid, temperature of July was lower than modern one on 1° (or exceeded it on 0,5°), of January – lower on 1–5°, of a year – lower on 1–4°, precipitation was lower on 25–75 mm.

At PB-1 (10000–10300 yrs), temperature of July was similar to modern one or on 0,5–1° lower, of January – on 1–2° lower, of a year – on 1–1,5° lower, and the amount of precipitation was lower on 25–50 mm. The climate was cool and dry. In PB-2 (9200–10000 yrs), some cold snap was marked, the climate was rather cool and humid. July temperature was on 1–2° lower than modern one, of January – on 2–3°, of a year – on 1,5–2°, the amount of precipitation was on 25 lower than nowadays.

At BO-1 (8800–9200 yrs), the climate became moderately cool and dry: July temperature was on 0,5–1° lower than the present one, of January – on 1–2°, of a year – on 1–2°, and precipitation – on 50 mm lower than the modern one. In BO-2 (8500–8800 yrs), the climate became warmer and dryer. The July, January and year temperatures were similar to modern one or on 1o higher, the precipitation was similar to the recent one, or on 25 mm lower. The BO-3 (8000–8500 yrs) was marked by a cold snap: the temperature of July was 1° lower than modern one, of January and a year – on 1,5–2° lower, the precipitation was lower on 50 mm.

At the climatic optimum (AT; 5000–8000 yrs), the warm and humid climate with moderately – mild winter was typical. The average year temperatures in the region were higher than modern ones on 1–2°, a year precipitation exceeded modern one on 50 mm. In the middle of AT period, the interval is revealed (AT-2; 6000–6600 yrs) with less warm and humid climate. July temperature exceeded modern one on 1–1,5°, of January – on 0,5°, of a year – on 0,5–1°, and precipitation was approximately similar to the modern one or exceeded it on 50 mm or less.

For SB-1 (4000–5000 yrs), the cold snap and decrease of climate humidity is characteristic. Temperature of July was lower than modern one on 1° or less, of January – on 1–2°, of a year – on 0,5–1°, in the northern regions, precipitation was less on 20–25 mm, in a central part of Belarus, it was around its modern values. The climate was moderately-warm and dry. At SB–2 (2500–4000 yrs.), the climate became warm and humid. For the interval 2500–3000 yrs, the temperature of July, January and a year increased on 0,5–1°, and the amount of precipitation exceeded its modern level on 50–75 mm or was similar.

At SA-1 (1600–2500 yrs), two phases have been distinguished: during SA-1-a, the cold snap with the spike 2300–2400 yrs ago was marked, which was characterized by a decrease of temperature of July on 0,5–1°, of January – on 1–2°, of a year on 0,5–1,5°, by reduction of precipitation on 25–50 mm. During SA-1-b, around 1700–1900 yrs ago, the climate

became warmer than nowadays. Temperature of July was higher on 1°, of January – on 0,5–1°, of a year – on 0,5–1°, precipitation was higher on 50 mm.

In SA-2 (1600–700 yrs), four phases have been established: in SA-2-a (1500 yrs ago), there was a cold snap, and temperature were lower than the modern ones on 1–1,5°, the precipitation lower on 50 mm. In SA-2-b (1300–1400 yrs), the warm climate is marked, temperature became similar to the modern values, and the amount of precipitation increased on 50 mm. In SA-2-c (1200 yrs ago), the small cold snap is detected, temperature of July was lower than modern one on 1–1,5°, of January – on 1–1,5°, of a year – on 1–1,5°, precipitation was less than modern one on 50–75 mm. In SA-2-d, the July temperature and precipitation increased about 1000 yrs ago (so-called "small climatic optimum"): the temperature of July was higher than modern one on 0,5–1°, of January – on 0,5–1°, of a year – on 1°, precipitations was higher on 50 mm.

At the SA-3 (around 700 yrs ago), four phases have been recognized. At SA-3-a (600–700 yrs), there was a cold spell, so-called "Litle Ige Age": temperatures of July, January and a year were lower than the modern one on 1o, precipitation was less on 50 mm. In SA-3-b (300–400 yrs), there was some increase of temperatures of July, January and a year, their values were similar to the to modern ones, and the amount of precipitation exceeded the modern one on 50 mm. In SA-3-c (200 yrs), this warm interval was followed by a new cold snap. Temperature decreased on 1°, and the amount of precipitation decreased on 25 mm as compared to the present one. In SA-3-d, the increase of temperature up to its present value was marked. The temperature is increasing further: on 0,5–0,7° in 1999 and on 1° to the end of 2000.

For the last century, four climatic events are established: two cold snaps (1910–1920-ies and 1960–1970-ies) with duration approximately of 20 years, characterized by a decrease of temperature on 0,2–1°, and two warm intervals (1930–1950-ies and 1980–2000-ies) with duration about 30 years and an increase of temperature on 0,5–0,7°. If this short-period cyclicity is characteristic for each century (starting by a cold snap and finishing by a warming), at the boundary of XX–XXI centuries, it is possible to expect an extremely warm climate, and in the future, at 2010–2020 yrs, – a cold snap. Then a warmer interval will happen at 2030–2050 yrs, with the amplitudes of a similar rank (no more than 1°), as a development of 800–900-yrs climatic cycle complicated by a short-period cyclicity.

FOSSIL BURROWS OF GOFERS IN THE LOESS–ICE DEPOSITS OF NORTH–EAST SIBERIA AS A BANK OF PALEOECOLOGICAL INFORMATION OF THE LATE PLEISTOCENE

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A great volume of paleoecological information is conservated in deposits due to frozen conditions in cryolitozone.

Fossil ground squirrel burrows are the most informative of buried biological objects.

Burrows of ground squirrel Urocitellus subgenus and of other rodents (lemmings and mice), were found in Late Pleistocene ice-loess deposits of North-East of Eurasia. They differ by depth of location, structure, and content of cryoconservation materials.

Radiocarbon age of burrows is determined about 32–28 kyrs BP and the formation of burrows is connected with the Carga thermochron.

All isolated burrows have a litter, containing twigs of shrub, sedge remains, grasses, leave, moss particles, single seeds and fruits, wool of mammals.

Fed chambers of burrows are filled with seeds in good condition, and supply of fruits, the number of which reaches 400–600 thousand units.

Chitin remains of insects, their larva, eggshells, feathers, excrements, bones of small mammals as well as their (soft) somatic tissue were found.

These biological objects are in very good conditions. In the laboratory, adult plants were grown from moss spores on special substrata. Viability of seeds of higher plants have been proved, and the experiments on their growing are carried out.

At present paleoecological research of ice-loess strata is mainly carried out by spore-pollen analysis, supported with paleontological and paleopedological research.

Paleobotanical analysis of burrow contents allows to reconstruct vegetational cover in the past, as well as paleoclimatic conditions and to give a complete characteristic of phytocoenosis as the base for reconstruction of natural environment of Late Pleistocene.

Coleopterological analysis enables to determine insect species. As the majority of Coleoptera belongs strictly to certain biotopes and phytocoenosis, even a rather short faunistic list allows to restore a character of ecological conditions at the certain place and time. Research couldn't be restricted by several methods.

Methods of Late Pleistocene deposits biostratigraphy should include a more wide range of approaches (a complex analysis).

PHYSICS BASED CHRONOMETRY OF LOESS–PALEOSOL–SEQUENCES IN CENTRAL AND WESTERN EUROPE

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Since the 1980ies, luminescence (TL, OSL, IRSL) dating has developed as a powerful tool for the chronology of loess. It is now widely accepted that luminescence ages from loess are reliable for the entire last glacial cycle (ca 100 ka), but some authors have reported much higher ages (up to 800 ka) which apparently are consistent with other physical dating techniques.

Besides luminescence, radiocarbon dating of organic materials in loess (up to 40 ka cal) and K/Ar and Ar/Ar dating, respectively, of intercalated volcanic tephra layers are of major importance for the establisment of a timescale for loess-paleosol sequences. Magnetostratigraphy (remanent paleomagnetism and magnetic susceptibility) and isotope stratigraphy (10Be, 13C) have been increasingly used for correlation with well-dated Quaternary sequences, e.g. marine isotope and ice-core chronologies.

Luminescence dating from loess is most advantageous because it directly dates the sedimentation and, thus, is applicable to any sample from genuine loess. It suffers, however, from rather large error bars (ca. 10% or more). Combination of luminescence and magnetic or isotope geochemical dating, however, has now proved to establish high resolution chronologies.

Examples from central Europe and western Europe will be presented. At the sites of Nussloch near Heidelberg (Germany), Achenheim (Alsace, France) Toenchesberg (East Eifel Volcanic Field, Germany) and Koblenz-Metternich high resolution loess-paleosol sequences from the last glacial-interglacial cycle have been studied by means of luminescence dating, magnetostratigraphy and isotope geochemistry by several groups. Some of these sections were presented at the international conference "Loessfest 99". Thus, a well-based chronology exists now for the Upper and Middle Rhine area. Based on luminescence dating and pedostratigraphic correlations this chronological frame is roughly adopted to loess sections farther east, in Austria, Czechia and Hungary. Application to Ukrainian loess appears very likely according to the pedostratigraphic results presented at the "Loessfest 99" by Z. Matviishina, but needs confirmation by luminescence dating.